YORKSHIRE PHILOSOPHICAL SOCIETY.

ANNUAL REPORT

FOR

MCMX.

BRITISH MUSEUM NATURAL HISTORY

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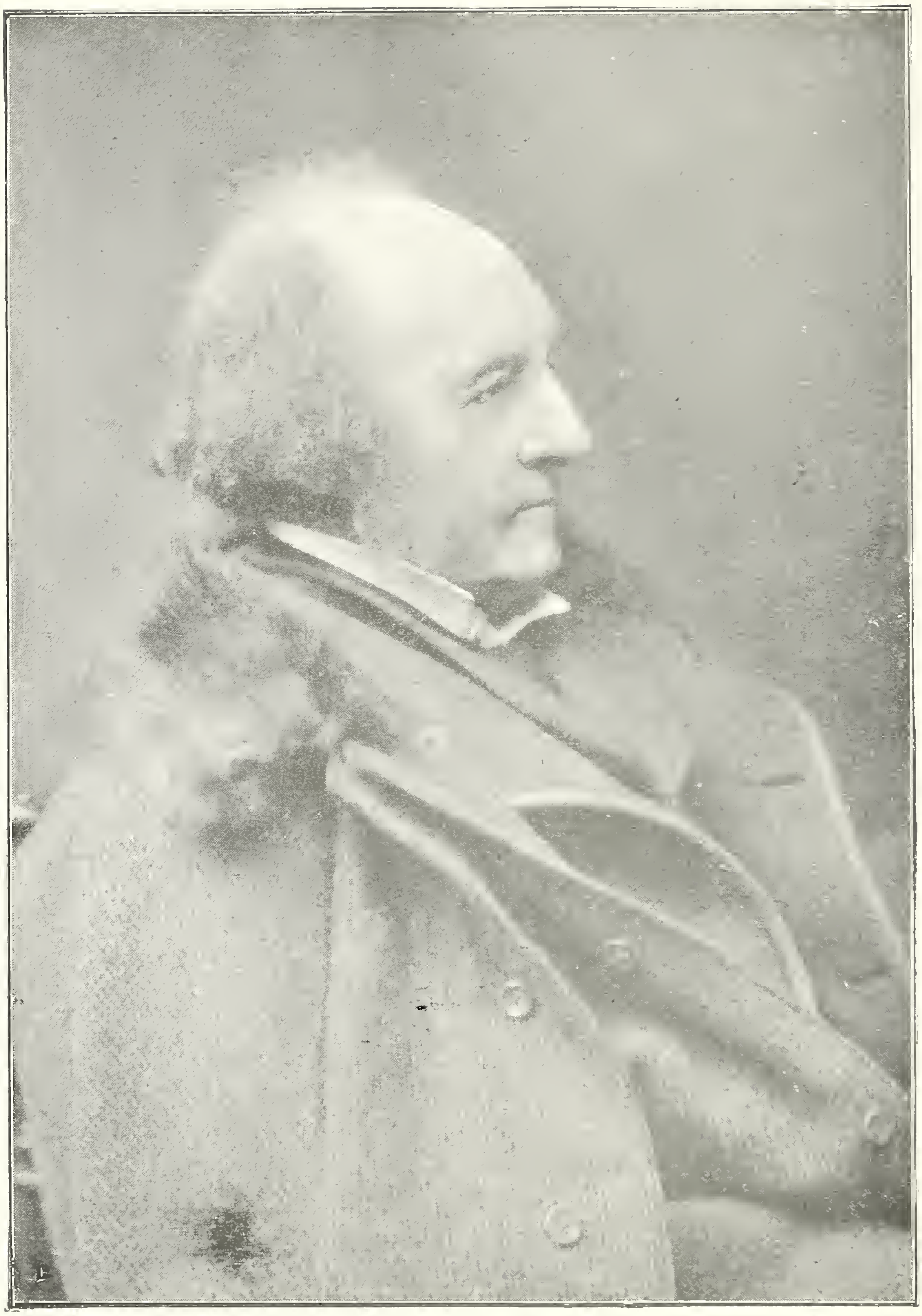

C. W. Strickland

ANNUAL REPORT

OF THE COUNCIL

OF THE

YORKSHIRE

PHILOSOPHICAL SOCIETY

FOR

MCMX.

PRESENTED TO THE ANNUAL MEETING,

FEBRUARY, 1911.

YORK:
COULTAS & VOLANS LTD., PRINTERS, LITTLE STONEGATE.
1911.

TRUSTEES
OF
THE YORKSHIRE MUSEUM,
APPOINTED BY ROYAL GRANT,

TEMPEST ANDERSON, M.D.
GEORGE A. AUDEN, M.D.
LORD DERAMORE.
CHAS. E. ELMHIRST.
SIR GEORGE GIBB, LL.B.
EDWIN GRAY, LL.M.

PATRONS
OF THE
Yorkshire Philosophical Society.

HIS MAJESTY THE KING.

HER MAJESTY THE QUEEN.

QUEEN ALEXANDRA.

OFFICERS OF THE SOCIETY, 1911.

PRESIDENT:

Tempest Anderson, M.D., D.Sc.

VICE-PRESIDENTS:

The Very Rev. the Dean of York.
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Richard Thompson.
H. M. Platnauer, B.Sc.
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M. Spence.
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HON. TREASURER:

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Elected 1909...Rev. E. C. Owen, M.A.
H. V. Scott.
H. C. Shann.
Elected 1910...G. Benson, A.R.I.B.A.
Sir Joseph Sykes Rymer.
Rev. J. Solloway, D.D.
J. Triffitt.
Elected 1911...G. E. Barton.
W. A. Evelyn.
S. Walker.
W. Wilkinson.
*L. Foster.

HON. SECRETARIES:

Tempest Anderson, M.D., D.Sc.
Chas. E. Elmhirst.

* For one year in place of E. R. Tate.

CURATORS:

ARCHÆOLOGY	T. BOYNTON, F.S.A. Rev. J. SOLLOWAY, D.D. G. BENSON. W. A. EVELYN.
GEOLOGY	Rev. W. JOHNSON, B.A., B.Sc.
MINERALOGY	H. M. PLATNAUER, B.Sc.
COMPARATIVE ANATOMY	T. ANDERSON, M.D., D.Sc.
ORNITHOLOGY	J. BACKHOUSE, F.Z.S., M.B.O.U.
BOTANY	H. J. WILKINSON.
OBSERVATORY	DENNIS TAYLOR.
METEOROLOGY	THE REV. W. JOHNSON, B.A.
NUMISMATICS	C. WAKEFIELD.
ENTOMOLOGY	S. WALKER.
LIBRARY	H. M. PLATNAUER, B.Sc.

GARDEN COMMITTEE:

J. MELROSE, J.P.
M. SPENCE.
H. J. WILKINSON.
G. YELD, M.A.
G. BENSON.
S. WALKER.
THE SECRETARIES (*ex-officio*).

LECTURE COMMITTEE:

G. YELD.
H. M. PLATNAUER, B.Sc.
R. THOMPSON.
THE SECRETARIES (*ex-officio*).

PHOTOGRAPHIC SECTION:

President:
DR. TEMPEST ANDERSON.
Vice-President:
J. N. KITCHING.
Secretary:
M. SPENCE.

NATURALISTS' SECTION:

President:
DR. TEMPEST ANDERSON.
Vice-Presidents:
H. J. WILKINSON.
S. WALKER.
W. INGHAM.
R. DUTTON.
Secretaries:
S. SMITH.
V. G. F. ZIMMERMAN.

KEEPER OF THE MUSEUM:

OXLEY GRABHAM, M.A., M.B.O.U.

REPORT OF THE COUNCIL

OF THE

YORKSHIRE PHILOSOPHICAL SOCIETY,

FEBRUARY, 1911.

IN presenting the Annual Report for the year 1910, the Council feel that it should first place on record the loss sustained by our Society, in common with the Nation and Empire, in the death of our Patron, King Edward VII. His late Majesty first granted his Patronage in 1866, as Prince of Wales, and renewed it on his Accession in 1901. It is a matter for congratulation that His Majesty King George V. and his Royal Consort, in response to our application, have graciously consented to become Patrons of our Society.

One of the principal objects of the founders of the Society was to safeguard and preserve the Historic Buildings of our city. During the past year your Council have twice intervened for this purpose, and we are glad to say, each time successfully—first in the case of St. Helen's Church, which it was proposed to first close and then remove, and secondly in that of Christ Church, King's Square, which was to be handed over to the York Corporation for destruction. Your Council wrote to the Archbishop of York, pointing out the beauty and interest of St. Helen's Church, and were assured, in reply, that it should be preserved, and appointed a deputation to wait upon the City Council and draw their attention to the loss the city would sustain by the removal of Christ Church. Interesting reports were prepared by Dr. Solloway and Mr. Benson, setting out the history of Christ Church from an Archæological and Architectural point of view, and these were laid before the City Fathers, who decided for the present, at all events, to allow the old Church to stand.

In January, 1909, a comprehensive report was prepared and submitted to your Council by Messrs. Platnauer and Benson, upon the stonework of the ruins in our gardens. They reported that considerable damage was going on, arising partly by mechanical and partly by chemical agencies.

During the past year your Council has devoted much time and attention to this matter.

Vegetable growth, a fruitful source of decay, has been removed from the Multangular Tower and Roman Wall. The stonework affected by the chemical action of the acids in the smoke-laden air, has been carefully pointed with cement, in such a way as to preserve it for many years to come, without injuring or altering its original appearance or archæological interest. The best thanks of your Council and Members are due to Mr. Benson, who very kindly undertook to supervise the work. Much has been done, but more remains to be done. St. Leonard's Hospital is in constant need of attention, and experiments have been, and are being, made to discover the best mode of treatment to check the disintegration of the limestone.

During the year the Museums Association held its Annual Conference in York (July 6—9), under the auspices of this Society. It is interesting to record the fact that the Association was instituted by Mr. H. M. Platnauer, when Keeper of the York Museum, in 1888, and held its first Conference in 1890. The Conference of 1910 was, therefore, its 21st, and there was a generally expressed wish on the part of the members that the "coming of age" meeting should be held in the city in which the Association was born. The meeting was under the Presidency of Dr. Tempest Anderson, Mr. Platnauer and Mr. Grabham acting as local secretaries. Some 60 or 70 members attended from all parts of the Empire, a record attendance; much good work was done, and the visitors were able not only to see the principal antiquities of the city, but also to make interesting and pleasant visits to Castle Howard and Fountains Abbey. Our President gave a very delightful reception in the Museum Gardens, to which all members of the Yorkshire Philosophical Society were invited. It was generally agreed that the Meeting was one of the most successful in the history of the Association, and the response to the appeal for funds for the expense of the Conference was so generous that, after payment of expenses, a sum of over £13 was left, and was divided between this Society and the Museums Association. The next Conference was fixed to be held at Brighton, and Mr. H. M. Platnauer was elected President for the year.

Another important event in the past year was the visit of the Cambridge University Extension Society, who departing, only for the second time, from their usual practice of holding the Summer Meeting in Cambridge, elected to come to York, one of their oldest centres. The Inaugural Address was delivered by the Archbishop of York on Friday, July 22nd, and Courses of Lectures, too numerous to be mentioned, followed during the next 3½ weeks, on the History, Literature, Archæology, etc., of the early and mediæval times, with special reference to Yorkshire. The Festival Concert Rooms and the Assembly Rooms had been taken as the main *habitat* of the Meeting, but our Society also lent its Lecture Theatre for smaller lectures, and the privilege extended to all ticket holders of using the Library and Gardens was, we are told, much appreciated. One of the most successful of the evening lectures was delivered by the President, Dr. Tempest Anderson. The Rev. E. C. Owen, the President of the York Centre, took a great interest in the visit, and was largely responsible for carrying out the local arrangements.

The Aviaries on the east side of the Museum were very dark, and it was felt that the birds required more sunshine. Some of the members, who took an active interest in the birds, met under the presidency of Mr. William Wilkinson, and sufficient funds were raised by private subscription to erect a much improved Aviary, near the Bowling Green, which the Council has every reason to believe has been thoroughly appreciated both by the birds and the members of your Society.

The plans for the new Lecture Theatre, so generously proposed to be erected by our President, Dr. Tempest Anderson, are now complete, and plan, elevation and section are appended to this Report, and will appear in the local Press. It is hoped that the coming year will see this important addition completed, and the Council feel that they cannot too warmly thank Dr. Anderson for his munificent gift.

The Spring and Winter Lectures, a list of which will be found on page x, have been full of interest and well attended, and, in addition to the above, three special Natural History Lectures for children were given by Messrs. Oxley Grabham, Chas. E. Elmhirst, and H. Lazenby, to crowded audiences, and appeared to be much appreciated. The monthly Afternoon Meetings of the Society, at which original papers are read, have been well maintained.

The Financial Statement, owing to the expenditure on the ruins and greenhouses, shews a deficit on Income Account of £172 16s. 6d., but thanks to the receipts from the Pageant, this still leaves a balance in the hands of the Treasurer of £228 3s. 1d.

During the past year your Society received a handsome Legacy of £250 from the late Mr. Henry Cowling. This has been applied in reduction of the amount still due to the Yorkshire Insurance Co. Ltd., with the very satisfactory result that the annual payment to that Society is reduced by £68 5s. 6d., until the debt is cleared off in October, 1914.

Your Council recommend Mr. Frank Green as a Vice-President in the place of Sir George Gibb, who has left York, and Messrs. G. E. Barton, W. A. Evelyn, S. Walker, and Wm. Wilkinson as new Members of Council in the place of these retiring by rotation, also Mr. L. Foster, for one year, in the place of Mr. E. R. Tate.

The Society has lost 7 Members and 1 Lady Subscriber by death, and 28 Members, 7 Lady Subscribers, and 2 Associates by resignation. These losses have been more than counterbalanced by the increase in new members.

The Lectures delivered in the evenings were as follows:—

Thursday, January 6th.—"Explorations in Palestine," (Illustrated by Lantern Pictures). By Col. Sir Chas. M. Watson, K.C.M.G., C.B., R.E., M.A.

Thursday, January 20th.—"The York Pageant," (Illustrated by Lantern Slides by W. Watson). By the Rev. J Solloway, D.D.

Thursday, February 3d.—"Carnival Customs." By E. Sidney Hartland.

Thursday, February 17th.—"String Figures," (Illustrated by Lantern Slides and Demonstrations.) By Harold Wager, F.R.S.

Thursday, March 3rd.—"New Zealand," (Illustrated by Lantern Pictures), By the President, Tempest Anderson, D.Sc.

Thursday, March 10th.—"African Native Races," (Illustrated by Lantern Pictures). By Sir Alfred Pease, Bart.

Thursday, March 17th.—"A Venetian Amateur in the 18th Century," (with Musical Illustrations). By Miss M. M. Paget.

Thursday, April 21st.—The Members of the Photographic Section gave a Lantern Night, when the following Members exhibited Slides:—

T. W. Pottage, "What the eye sees in our own country."

H. Lazenby, "A Series of Photographs illustrating the Travelling Post Office and a few miscellaneous ones."

M. Spence, "The Old and New."

Thursday, October 6th.—"The Mysterious Republic (Andorra)," (Illustrated by Lantern Pictures). By the Rev. T. T. Norgate.

Thursday, October 13th.—"Matavanu, a New Volcano in Savaii, German Samoa," (Illustrated by Lantern Pictures). By the President, Tempest Anderson, D.Sc.

Thursday, October 27th.—"Across the Heart of China," (Illustrated by Lantern Pictures). By the Earl of Ronaldshay, M.P.

Thursday, November 10th.—"The Castles of England," (Illustrated by Lantern Pictures). By the Rev. Jocelyn Perkins, M.A.

Thursday, November 24th.—"Our Insect Friends and Foes," (Illustrated by Lantern Pictures). By F. Martin Duncan, F.R.P.S.

Thursday, December 8th.—"The Roman Wall," (Illustrated by Lantern Pictures). By Thos. W. Thornton.

The following Papers were read at the monthly meetings of the Society during 1910:—

January 10th.—"Through Canada to the Rockies." By the Rev. W. Johnson, B.A.

March 14th.—"Pine Cones." By Dr. C. K. Hitchcock.

April 11th.—"Curiosities of Early Railway Travelling." By Malcolm Spence.

October 10th.—"York during the Reign of Edward I." By G. Benson.

November 14th.—"Majorca." By Dr. J. H. Gostling.

December 12th.—"Peasant Life and Sport in Galway." By Sydney H. Smith.

ANTIQUITIES.—The Roman Wall and Multangular Tower had suffered much from the growth of vegetation, roots having penetrated between the stones and loosened many of them. Rain falling from branches of trees overhanging the wall had also done much damage to the magnesian limestone facing. The mortar to the joints had decayed so much that many of the stones were in danger of falling away from want of support. The principal work during the year has been the remedying of these defects by removing vegetation from the tower and walls, lopping off overhanging branches, and re-pointing the Tower and the greater part of the Wall. The work had to be carefully done, and has entailed considerable expense.

BOTANY.—The specimens in the Herbarium are in good condition. No additions have been made during 1910.

ENTOMOLOGY.—Though no additions to the Entomological collection have been made, it is pleasing to report a much increased interest that has been taken in this Section during the past year. Many visitors from remote places have come to inspect the "Allis" collection—one of the best of British Lepidoptera that any provincial Museum possesses.

GEOLOGY.—Whilst no particular additions have been made in this department during the past year, all the specimens and cases have been thoroughly cleaned, and are in good order.

LIBRARY.—The Hon. Curator reports that the additions to the Library have been of the ordinary kind, nothing has been obtained that needs special mention. The additions shortly to be made to the Museum by the President include provision for the Library, so there is every prospect that before another year has passed, the present congestion in this department may be at an end.

MINERALOGY.—The collections are in good order. A fine group of Celestine crystals has been presented by Mr. W. Whitaker, and Mr. Max Ailion presented some beautiful cut specimens of amethyst, hyacinth, cinnamon-stone, spinel, ruby, onyx and turquoise, and a few specimens of rough gems.

METEOROLOGY.—*Statistics of Station:*—Longitude, 1° 5′ W.; Latitude, 53° 57′ N.; height above mean sea level 56 feet.

Temperature ranged in 1910 between 12° F. and 79° F., the average mean temperature for the year being 48·7° as compared with 47·5° F. for 1909. The lowest temperature was recorded on Jan. 27th, when the absolute minimum thermometer read 12° F., while the highest reading was taken in June 19th, when the reading was 79° F. Thus there was no long period of high temperature.

A Mean Pressure of 29·848 inches has been recorded at mean sea level, as against 29·916 inches for 1909. February was lowest with 29·530 inches, November next with 29·598 inches. September was highest with 30·325 inches, March next with 30·141 inches, although October with 30·037 inches came close behind, continuing the good weather of September, and giving us one of our finest "back-ends." The extreme range of pressure was 2·070 inches as compared with 2·377 inches in 1909 and 2·011 inches in 1908. The highest reading 30·648 inches was taken on March 31st, at 9 a.m., the lowest 28·578 inches on November 7th, at 9 a.m.

Rain or *Snow* (0·005 inches or more) fell on 207 days, 18 days fewer than in 1909, and the total amount was 24·64 inches as compared with 24·75 inches for 1909. Yet the even distribution of this amount reduced its adverse influence, and we hardly think of 1910 as a rainy year. August, July, and April, were our wettest months, with totals respectively of 2·82, 2·73, and 2·66 inches respectively. Frequently our wettest months gives us well over 4 inches, and rarely have we had so dry a month as September.

The cumulative totals for the wettest months since 1841 are now October 188·65 inches, August 186·57 inches, July 174·09 inches. The heaviest fall occurred on July 5th, when ·92 in. fell.

Observations on the winds show that we have had during 1910 "strong winds" on 30 days, 1 gale, 5 "calms." The chief air currents have been W. (169), N. (124), S. (163), S.W. (72), N.W. (72), E. (52).

We have had 40 days of "clear" sky, against 49 in 1909, 127 days of "overcast" as against 128 for 1909. We had

12 thunderstorms and 15 fogs. Snow fell on only 15 days of the year, as against 31 for 1909.

Bright sunshine has been observed for 1229 hours as against 1145 for 1909. We have thus got back the 2 °/。 lost in 1909.

ORNITHOLOGY.—The collections are all in good order, and several interesting additions have been made in the way of mounted specimens, skins and eggs.

ZOOLOGY.—The Yorkshire Mammal collection is gradually increasing, and some interesting varieties have been added. Mention may be made of the three American Grey Squirrels which have been turned down in the Gardens, and which were kindly presented by Mr. W. H. St. Quintin.

FIELD NATURALISTS' SECTION.—Your Council have to report that on the whole the Society has enjoyed a prosperous year, during which a large amount of routine work has been accomplished in all its branches. The session of 1910-11 opened with a series of field excursions that proved to be very useful and instructive to those members who attended them, but we feel that the excursions are not supported as much as they should be, and the attendance by no means justifies all the care and attention that is required to arrange them. The first, to Stamford Bridge and Buttercrambe Woods, attracted ten members; the second, to Speeton and Bempton Cliffs, was attended by nine members and three friends. On the third, to Sledmere, we had ten members and two friends; on the fourth, to Kirbymoorside, in conjunction with the Yorkshire Naturalists' Union, six members and two friends; and the fifth and last, to Bramham Park, only called together four members and one visitor. Results such as these, after all the trouble of arranging details, are most disappointing, and it is for the general body of members to state whether or not the excursions should be discontinued in view of such small attendances, and of the cost of printing and posting one hundred notices on each occasion.

The Winter Session opened with the Presidential address by Dr. Tempest Anderson, M.D., F.G.S., on "Volcanoes," the lecture being given jointly to our Society and to the Photographic Section of the Philosophical Society, Dr. Anderson having been elected President of the Photographic Section, as well as President of the Naturalists' Society. This lecture was followed by a paper by Mr. Geo. Machin upon "Some Insects of the Hambleton Hills," and at the same meeting exhibits of Lepidoptera were explained by Mr. Harry Dobson and Conchological specimens by Mr. Harry Sowden. Mr. Oxley Grabham gave us a splendidly illustrated lecture on "Wild Sports of Yorkshire." Two carefully prepared ten-minute papers were those of Mr. Wm. Bellerby and Dr. A. H. Burtt, respectively entitled "Fungi" and "Notes on the growth of certain Conifers." Mr. A. H. Brierley filled in an evening with a first-rate paper on "The Great-Crested Grebe on Yorkshire Lakes," a specimen of the bird being exhibited by Mr. S. H. Smith, eggs of various grebes by Mr. V. J. F. Zimmerman, and a case of eggs of hawks and herons by Mr. G. A. Howard. A lantern lecture was given by Mr. Sydney H. Smith, entitled "Peasant Life and Sport in Galway." The botanical section of the Society is very strong, and not the least able of its workers is Mr. J. H. Evers, whose lecturette entitled "A Corner of Strensall Common," amply proved the lecturer's powers of close observation. We are supposed to restrict our field notes to a radius of twenty miles around York, but none of the audience regretted our stretching a point to have the opportunity of hearing a description of "Muskoka, in Canada," by Miss Winifred Bishop, a keen student of Natural History, who had many interesting things to tell us pertaining to that beautiful country.

Mr. C. F. Procter gave us a splendid lantern lecture entitled "Wildfowling on the Humber Estuary," in which he described punt-gunning, and shore-shooting from screens and banks, together with many other methods adopted by wildfowlers to secure their quarry. The Botanical Section had another enjoyable evening when Mr. H. J. Wilkinson described "An Old Herbal"—a resumé of an ancient botanical work by Henry Lyte, dated 1578. "Spices and Condiments" was a subject dealt with in a most attractive manner by Dr. C. K. Hitchcock; and the last of the season's lectures was given by

Mr. F. W. Lockwood, a painstaking student of geology, who took as his subject "Some Yorkshire Rivers."

The Society is to be congratulated upon possessing such an enthusiastic band of sectional officers, and as these gentlemen had been fairly well supported by the members of the various sections, the result was that on the evening devoted to receiving their reports the only account not presented was that on Conchology, and that merely because this section has been previously so well worked that there was practically nothing to report. Mr. F. W. Lockwood dealt with Geology, Mr. Wm. Ingham, B.A., with Botany, and Mr. V. J. F. Zimmerman gave an interesting account of our local Ornithology. Mammalia and Pisces were reported upon by Mr. C. F. Procter, this being the first account that had been entered in the Recorder's book in this section; and quite the longest report was that on Lepidoptera, by Mr. Ralph Moore. Your Committee wish to thank Mr. Herbert Stansfield for his gift of "Nature Notes" for the years 1906-7, and for "The Life of an Eighteenth Century Naturalist," (James Bolton, of Halifax), written by Mr. Charles Crossland. They also wish to place on record their indebtedness to Mr. Stansfield for his ungrudging services as Hon. Treasurer, whose audited report shews your Society to have a cash balance of 8s. 6d. and a balance at banker's of £31 17s. 8d., the total £32 6s. 3d. being carried forward to the next year's accounts. Although the Society is in a flourishing condition, your Council regret to notice a decrease in the number of new members added during the year, only four being proposed; also an increase in the number of resignations, three being given in at the last meeting. Both facts are very regrettable, and although the latter has been caused by unavoidable circumstances, such as business pressure and departure from the city, we nevertheless sincerely trust that all our members will make individual efforts to introduce naturalist friends, with a view to securing them as members of this Society, and also themselves endeavour to attend the meetings as regularly as possible. We commenced the year with 92 members; 4 new ones were elected, making a total of 96. Deducting 1 deceased, 3 resigned, and 9 struck off through non-payment of subscription, this leaves the present number of members at 83, a net decrease of about 14 per cent. It is often a source of great disappointment to those who have prepared papers or lectures, very often at great inconvenience and considerable expense, to find only the most meagre attendance at the meeting when they are called upon to deliver them. We sincerely trust that during the coming session of 1911-12 fresh efforts will be made to improve further the usefulness and the status of this old-established York District Field Naturalists' Society.

SYDNEY H. SMITH, Hon. Sec.

PHOTOGRAPHIC SECTION.—The number of members remains very much as it has done during the last two or three years, and three meetings have been held. At the Annual Meeting on the 3rd January, 1910, the President and various officers were appointed, after which the Secretary, Mr. Malcolm Spence, gave a description of a method of producing so-called "Fireside" and "Lamplight" studies and portraits, and showed by actual demonstration and lantern slides how this can be effected. The next meeting was held on the 16th Feb., 1910, at 4-30 in the afternoon. The members met in the Museum Library, and then proceeded to the Engineers' Office of the N.E. Railway Company, where the photographic processes employed in the reproduction of large plans, drawings and documents, were explained by Mr. Maughan and the operator, Mr. J. G. Bruce. Some of these processes were new to several of our members, and a very interesting and instructive hour was passed. The last meeting was held on the 16th March, 1910, when a paper was read by Mr. Reginald Peters upon "Photographic Efficiency." He dealt with the inaccuracy and inefficiency of some types of shutters, after which he proceeded to develop by the Thermal system, as distinguished from the Factorial system, several plates, to which he had given exposures of widely varying duration, with the object of showing that by this method practically identical results could be obtained. The developer being well diluted, there was little chance of making over exposed plates too dense, while the contrast in under-exposed plates was not excessive.

On the 21st April, 1910, the members of the Yorkshire Philosophical Society were invited, in accordance with the usual custom, to the annual Lantern Exhibition given by the members of the Photographic Section. Three members exhibited slides, viz. :—" What the Eye sees with the Camera in our own country," by T. W. Pottage; "The Travelling Post Office and a few Miscellaneous Slides," by Herbert Lazenby ; " The Old and the New," by Malcolm Spence.

The annual meeting of the Yorkshire Photographic Union took place at Halifax on 23rd April, 1910, as part of which the usual show of photographs took place, and the photographs contributed by our section elicited general approval.

Six years having elapsed since our Section held a public exhibition of photographs, it was decided to hold a Summer Exhibition during the summer of 1910. This was held on 2nd July, 1910, and during the following week, and upwards of 200 contributions were sent in, these being hung on the walls of the Library. The exhibition was favourably reported on in the public Press, and the result of the above exhibitions shows that the Section, though not large, continues to turn out work of which the members may well be proud.

The Balance Sheet for the Session 1909-10 is incorporated with this Report, and copies have been placed on the table, from which it will be seen that—

The credit balance brought forward was	£0	10	0
The ordinary income	4	0	0
The arrears	1	5	0
	5	15	0
Total expenditure was	4	3	3
Leaving a balance of	1	11	9

METEOROLOGICAL STATION, YORK.—THE MUSEUM.

Longitude 1° 5′ W., Latitude 53° 57′ N. Height above Mean Sea Level 56 ft. Gravity Correction + ·024 in.

1910.	Mean Pressure at 32° Fahrenheit.		Air Temperature.										Humidity.									Earth Temp.	
	At M.S. Level	At Station Level.	9 a.m.	9 p.m.	Mean.	Means of		Min. & Max. Combined.	Absolute Max. and Min.				Depr. of Wet Bulb.			Tension of Vapour.			Percentage.			At 1 ft.	At 4 ft.
						Max.	Min.		Max.	Day.	Min.	Day.	9. am.	9 p.m.	Mean.	9 a.m.	9 p.m.	Mean.	9 a.m.	9 p.m.	Mean.		
	ins.	ins.	°	°	°	°	°	°	°		°		°	°	°	in.	in.	in.	%	%	%	°	°
Jan.	29·742	29·685	36·4	37·1	36·8	42·8	32·8	37·8	55	2 & 9	12	27th	0·8	0·7	0·8	·200	·207	·204	93	94	94	38·5	41·9
Feb.	29·530	29·473	39·5	39·6	39·6	46·1	35·6	40·9	54	17th	30	9th	1·4	1·2	1·3	·214	·219	·217	89	90	90	37·7	40·0
Mar.	30·141	30·083	42·6	42·5	42·6	51·3	36·9	44·1	59	20th	28	29th	2·1	2·2	2·2	·229	·226	·228	85	83	84	40·9	41·2
April	29·795	29·737	45·0	44·3	44·7	52·8	36·7	44·8	62	21st	26	1st	3·0	2·3	2·7	·233	·241	·237	78	82	80	44·6	44·0
May	29·889	29·831	52·5	49·6	51·1	60·8	44·2	52·5	75	23rd	34	3rd	2·9	2·1	2·5	·319	·303	·311	81	86	84	50·7	47·2
June	29·889	29·831	60·5	56·0	58·3	67·3	50·3	58·8	79	19th	44	17th	4·6	2·9	3·8	·386	·368	·377	71	82	78	57·7	53·1
July	29·857	29·799	57·9	55·7	56·8	65·4	50·6	58·0	74	13th	44	3 & 4	3·2	2·5	2·9	·388	·374	·381	80	84	82	58·6	55·7
Aug.	29·830	29·772	59·7	57·7	58·7	67·9	52·4	60·2	75	14th	45	23rd	2·9	2·2	2·6	·422	·412	·417	83	86	85	60·0	57·5
Sept.	30·235	30·177	54·6	52·7	53·7	61·7	47·2	54·5	71	28th	38	21st	2·8	2·1	2·5	·350	·342	·346	82	86	84	56·5	56·3
Oct.	30·037	29·979	51·7	51·1	51·4	58·0	46·2	52·1	70	1st	40	20, 21 31	2·6	1·7	2·2	·317	·332	·325	83	88	86	53·1	54·2
Nov.	29·598	29·541	36·1	36·6	36·4	43·6	31·8	37·7	53	1st	23	23rd	1·3	1·1	1·2	·188	·196	·192	88	91	90	42·8	48·3
Dec.	29·638	29·581	43·1	42·3	42·7	47·4	38·8	43·1	56	24th	27	28th	1·1	1·2	1·2	·254	·244	·249	91	91	91	41·7	44·3
Year	29·848	29·791	48·3	47·1	47·7	55·4	42·0	48·7	79	June 19th	12	Jan. 27th	2·4	1·9	2·2	·292	·289	·291	84	87	86	48·6	48·6

STATION, YORK.—THE MUSEUM.

Heights above Ground :—Barometer, 3 feet ; Thermometers, 4 feet ; Rain-gauge, 1 foot.

1910.	Amount of Cloud.			Rainfall.			Weather, No. of Days of									Wind, No. of Observations of								
	9 a.m.	9 p.m.	Mean	Total.	Max.	Day.	Rain.	Snow.	Hail.	Thunder Storm	Clear Sky.	Over-cast.	Fog.	Gale.	Strong (Wind 4-7)	N.	N.E.	E.	S.E.	S.	S.W	W.	N W	Calm.
				ins.	ins.																			
Jan.	5·9	6·7	6·3	2·21	·55	27th	18	7	0	0	3	11	3	0	5	9	1	2	0	16	12	16	6	0
Feb.	6·8	4·6	5·7	2·07	·32	1st	20	2	0	0	5	9	1	1	8	3	0	0	2	22	14	12	3	0
Mar.	6·5	4·6	5·6	0·48	·11	8th	11	1	0	0	5	9	1	0	0	8	1	5	7	11	7	12	10	1
April	7·6	6·1	6·9	2·66	·73	14th	20	0	2	2	3	10	0	0	2	12	7	4	2	8	6	16	5	0
May	6·5	4·8	5·7	2·36	·66	21st	20	1	2	2	4	8	1	0	3	16	4	9	2	7	3	15	6	0
June	6·8	6·9	6·9	2·07	·63	30th	10	0	1	4	2	12	0	0	0	7	10	8	3	5	5	19	3	0
July	8·2	7·5	7·9	2·73	·92	5th	14	0	0	1	0	13	2	0	0	15	7	0	2	15	7	9	7	0
Aug.	7·0	6·6	6·8	2·82	·52	14th	23	0	0	2	1	10	0	0	5	8	1	4	3	23	5	14	3	1
Sept.	7·0	5·3	6·2	0·23	·07	10th	7	0	0	0	4	12	0	0	1	25	2	2	5	5	2	9	9	1
Oct.	6·0	7·6	6·8	2·14	·40	2nd	11	0	0	1	3	12	3	0	2	10	8	12	0	7	5	14	6	0
Nov.	4·9	4·9	4·9	2·43	·73	10th	16	3	0	0	7	5	3	0	3	10	0	2	2	15	1	19	9	2
Dec.	7·5	7·0	7·3	2·44	·44	3rd	21	2	0	0	3	16	1	0	1	1	2	4	2	29	5	14	5	0
Year	6·7	6·1	6·4	24·64	·92	July 5th	191	16	5	12	40	127	15	1	30	124	43	52	30	163	72	169	72	5

RIVER HEIGHT RECORDS REGISTERED BY THE AUTOMATIC RECORDER AT THE GUILDHALL, YORK, 1910.

Date.	JANUARY.			FEBRUARY.			MARCH.			APRIL.			MAY.			JUNE.		
	Time.	Above or below S.L.		Time.	Above or below S.L.		Time.	Above or below S L.		Time.	Above or below S.L.		Time.	Above or below S.L.		Time.	Above or below S.L.	
		ft.	in.		ft.	in.		ft.	in.		ft.	in.		ft.	in.		ft.	in.
1	3 a.m.	3	6	12 p.m.	5	5	6 p.m.	3	1	noon	0	5	1 a.m.	0	9	12 p.m.	0	6
2	1 a.m.	2	8	,,	8	1	12 p.m.	3	9	,,	0	5	7 a.m.	0	8	noon	0	6
3	1 p.m.	1	10	6 a.m.	8	3	7 a.m.	5	6	,,	0	5	5 a m.	0	7	12 p.m.	0	8
4	5 p.m.	1	4	1 a.m.	6	10	12 p.m.	1	10	,,	0	5	noon	0	6	,,	0	6
5	1 p.m.	1	7	,,	4	1	noon	1	3	,,	0	4	,,	0	5	9 p.m.	0	3
6	1 a.m.	1	6	12 p.m.	9	9	6 p.m.	1	3	,,	0	3	12 p.m.	0	9	6 p.m.	S.L.	
7	,,	1	3	,,	10	9	noon	1	2	,,	0	4	,,	1	3	1 a.m.	S.L.	
8	noon	1	0	7 a.m.	10	11	,,	1	2	,,	0	5	noon	1	6	noon	S.L	
9	11 p.m.	2	4	12 p.m.	7	0	12 p.m.	2	8	1 a.m.	0	5	9 a.m.	1	2	,,	S.L.	
10	3 p.m.	5	9	,,	3	4	,,	2	2	noon	0	3	1 a.m.	1	4	,,	S.L.	
11	1 a.m.	4	8	2 p.m.	4	2	,,	1	6	1 a.m.	0	5	,,	0	10	,,	S.L,	
12	12 p.m.	1	11	12 p.m.	2	8	9 a.m.	1	1	noon	0	5	,,	0	7	,,	S.L.	
13	8 a.m.	1	3	,,	2	2	12 p.m.	1	0	,,	0	5	6 p.m.	0	3	,,	S.L.	
14	12 p.m.	8	1	noon	2	0	noon	1	0	1 a.m.	0	5	noon	0	3	,,	S.L.	
15	3 a.m.	8	6	12 p.m.	2	3	,,	1	0	12 p.m.	0	9	,,	0	3	8 p.m.	below 0	5
16	12 p m.	10	3	noon	2	6	1 a.m.	1	0	6 p.m.	1	9	12 p.m.	1	3	8 a.m.	0	8
17	noon	11	4	12 p.m.	8	0	noon	0	10	9 p.m.	2	6	8 a.m.	2	4	noon	0	5
18	12 p.m.	8	6	8 a.m.	8	7	,,	0	9	12 p.m.	1	7	1 a.m.	1	5	3 p.m.	0	5
19	,,	4	9	12 p.m.	3	6	,,	0	9	1 a.m.	1	6	noon	0	10	River drawn off.		
20	,,	2	11	,,	2	8	,,	0	9	noon	0	9	,,	0	10			
21	6 p.m.	1	9	,,	8	6	12 p.m.	0	6	1 a.m.	0	8	12 p.m.	1	6			
22	,,	1	3	noon	9	4	noon	0	7	,,	0	6	3 p.m.	0	9			
23	12 p.m.	1	3	12 p.m.	5	0	,,	0	7	noon	0	3	,,	0	9			
24	,,	1	6	,,	3	1	,,	0	6	12 p.m.	1	0	10 p.m.	0	4			
25	,,	1	0	,,	2	10	,,	0	6	2 p.m.	2	0	noon	0	3			
26	,,	0	9	,,	2	6	,,	0	5	1 p.m.	1	8	,,	0	2			
27	noon	0	5	,,	2	3	,,	0	5	3 p.m.	0	9	,,	S.L.		noon	above 0	6
28	12 p.m.	1	1	6 p.m.	2	0	,,	0	5	5 p.m.	0	6	,,	S.L.		,,	0	6
29	7 p.m.	1	0				,,	0	5	,,	2	0	,,	S.L.		,,	0	6
30	6 p.m.	0	9				,,	0	6	noon	S.L.		12 p.m.	0	3	,,	0	11
31	12 p.m.	1	4				,,	0	6				noon	0	3			

RIVER HEIGHT RECORDS.—*Continued.*

Date.	JULY.			AUGUST.			SEPTEMBER.			OCTOBER.			NOVEMBER.			DECEMBER.		
	Time.	Above or below S.L.		Time.	Above or below S.L.		Time.	Above or below S.L.		Time.	Above or below S.L.		Time.	Above or below S.L.		Time.	Above or below S.L.	
		ft.	in.		ft.	in.		ft.	in.		ft.	in.		ft.	in.		ft.	in.
1	10 a.m.	S.L.		1 a.m.	0	4	noon	0	11	noon	0	1	10 p.m.	5	3	1 a.m.	0	10
2	noon	0	9	noon	0	1	4 p.m.	0	10	,,	S.L.		12 p.m.	1	3	12 p.m.	2	0
3	6 p.m.	0	6	,,	0	1	1 a.m.	0	10	6 a.m.	0	1	11 p.m.	0	3	6 a.m.	2	1
4	1 a.m.	0	6	6 p.m.	0	3	noon	0	7	8 p.m.	0	4	10 p.m.	0	7	12 p.m.	3	0
5	,,	0	5	1 a.m.	0	3	1 a.m.	0	6	6 p.m.	0	1	4 p.m.	0	3	,,	4	6
6	12 p.m.	2	0	noon	0	1	,,	0	3	noon	S.L.		noon	0	3	4 p.m.	6	4
7	8 a.m.	3	8	,,	S.L.		8 p.m.	S.L.		,,	S.L.		6 p.m.	2	10	12 p.m.	2	10
8	1 a.m.	1	8	6 p.m.	below 0	2	noon	S.L.		,,	S.L.		12 p.m.	1	8	,,	1	0
9	3 p.m.	0	7	noon	0	1	1 a.m.	S.L.		,,	S.L.		noon	0	6	,,	2	2
10	1 a.m.	0	6	,,	0	2	noon	0	2	1 a.m.	S.L.		1 a.m.	0	11	,,	2	9
11	6 p.m.	S.L.		,,	0	2	,,	0	2	6 p.m.	S.L.		12 p.m.	2	6	9 a.m.	2	11
12	1 a.m.	S.L.		6 p.m.	0	4	,,	0	2	noon	S.L.		8 a.m.	2	10	8 p.m.	1	7
13	noon	0	3	noon	0	2	4 a.m.	0	3	6 p.m.	0	2	12 p.m.	6	5	12 p.m.	3	3
14	,,	0	3	,,	0	1	6 p.m.	0	1	1 a.m.	0	2	6 p.m.	8	9	10 p.m.	4	0
15	,,	0	2	,,	S.L.		noon	0	2	noon	S.L.		12 p.m.	3	9	11 p.m.	4	6
16	1 a.m.	0	2	1 a.m.	S.L.		1 a.m.	0	3	,,	S.L.		7 p.m.	1	4	12 p.m.	4	11
17	9 p.m.	0	2	noon	above 0	6	noon	0	2	12 p.m.	0	1	10 p.m.	0	8	4 p.m.	8	0
18	6 a.m.	0	2	1 a.m.	0	6	,,	0	1	5 p.m.	1	8	1 a.m.	0	9	11 p.m.	5	2
19	noon	0	1	12 p.m.	1	0	,,	S.L.		6 p.m.	2	3	12 p.m.	0	10	,,	2	3
20	,,	0	1	5 p.m.	1	7	,,	0	1	12 p.m.	1	5	9 p.m.	0	7	4 p.m.	2	6
21	,,	0	2	12 p.m.	2	3	,,	S.L.		4 p.m.	1	0	,,	0	5	6 p.m.	1	6
22	12 p.m.	0	4	2 p.m.	3	6	,,	0	1	12 p.m.	1	2	12 p.m.	0	7	9 p.m.	1	1
23	noon	0	4	11 p.m.	0	6	,,	0	2	,,	0	8	noon	0	6	11 p.m.	1	5
24	,,	0	5	9 p.m.	0	7	,,	0	1	6 p.m.	0	6	,,	0	6	12 p.m.	4	2
25	,,	S.L.		12 p.m.	0	5	,,	0	1	noon	0	5	,,	0	6	,,	1	3
26	10 a.m.	1	1	8 p.m.	1	11	,,	S.L.		,,	0	3	,,	0	6	11 a.m.	0	7
27	1 a.m.	0	9	,,	4	0	,,	S.L.		,,	0	2	,,	0	6	3 p.m.	0	7
28	3 p.m.	0	4	12 p.m.	0	5	,,	S.L.		,,	0	2	12 p.m.	2	5	12 p.m.	0	11
29	12 p.m.	0	5	10 p.m.	6	5	,,	S.L.		,,	0	2	11 a.m.	2	9	,,	1	4
30	2 p.m.	0	11	12 p.m.	3	3	9 p.m.	0	2	12 p.m.	0	6	12 p.m.	0	10	3 p.m.	1	8
31	1 a.m.	0	9	,,	1	2				noon	0	6				10 a.m.	1	1

OUSE FLOODS FROM RETURNS TO THE CITY SURVEYOR.

COMPARATIVE TABLE, 1910.

Date.	Nidd at Pateley Bridge.		Ure at Middleham Bridge.		Swale at Richmond.	
	Hour.	Height.	Hour.	Height.	Hour.	Height.
		ft. in.		ft. in.		ft. in.
Jan. 16					2 p.m.	4 0
.. 17					5-30 a.m.	2 9
Feb. 5			6-30 p.m.	5 0	3-45 a.m.	4 0
,, 6			8 p.m.	5 0		
,, 7					8-30 a.m.	2 0
,, 17					8-30 a.m.	6 0
,, 21					8-30 a.m.	5 0
Mar. 2			11 a.m.	5 0	5 a.m.	4 0
Nov. 1			10 a.m.	8 0		
,, 13					9-30 a.m.	5 0
Dec. 5					6 p.m.	3 6
,, 15					4-30 a.m.	2 6
,, 16					5 p.m.	3 0

YORK—THE MUSEUM.

Barometer at 32° and M.S.L.

1910.	Highest Barometer.	Lowest Barometer.
January	30·541 6th, 9 p.m.	28·669 28th, 9 p.m.
February	30·297 9th, 9 p.m.	28·701 20th, 9 p.m.
March	30·648 31st, 9 a.m.	29·500 9th, 9 p.m.
April	30·559 1st, 9 a.m.	28·953 13th, 9 p.m.
May	30·386 25th, 9 a.m.	29·317 6th, 9 p.m.
June	30·391 15th, 9 p.m.	29·408 30th, 9 a.m.
July	30·207 13th, 9 a.m.	29·328 25th, 9 a.m.
August	30·196 31st, 9 p.m.	29·408 26th, 9 a.m.
September	30·569 17th, 9 a.m.	29·830 29th, 9 a.m.
October	30·619 14th, 9 a.m.	29·023 31st, 9 p.m.
November	30·131 22nd, 9 p.m.	28·578 7th, 9 a.m.
December	30·398 30th, 9 p.m.	28·831 16th, 9 p.m.
Year	30·648 March. 31st, 9 a.m.	28·578 Nov. 7th, 9 a.m.

YORK (BOOTHAM)—SUNSHINE VALUES.

Month.	Total Hours.	Percentages.	
	1910.	1910.	1909.
January	47	19	9
February	58	22	16
March	123	34	15
April	93	22	42
May	159	32	43
June	166	33	22
July	139	28	22
August	136	30	38
September	111	30	22
October	93	29	23
November	80	32	25
December	24	11	11
Year	1229	28	26

THE TREASURER IN ACCOUNT WITH THE YORKSHIRE

Dr. INCOME.

	£	s.	d.	£	s.	d.	£	s.	d.
Subscriptions :									
Town Members				625	0	0			
Country Members				9	0	0			
Lady Subscribers				64	10	0			
Associates				12	10	0			
Arrears received				27	5	0			
Keys of Gates				62	17	6			
							801	2	6
Legacy :									
Executors of the late Henry Cowling							250	0	0
Donation :									
Museums' Association Conference							4	16	10
Rents :									
Major Allenby, St. Mary's Lodge				65	0	0			
Mr. Hill, Marygate Baths				40	0	0			
York Amateur Rowing Club				5	0	0			
York and District Field Naturalists' Society, less £2 paid to Attendant				1	0	0			
York Waterworks Co., for Shed				5	0	0			
Do. for Light				0	1	0			
Corporation of York—Lease of Exhibition Land ...				2	0	0			
Yorkshire School for the Blind, for Light				0	1	0			
Post Office, Wayleaves				0	2	0			
National Telephone Co., for Wayleave				1	0	0			
York University Extension Society—Use of Lecture Room				2	2	0			
							121	6	0
Whitsuntide Admission Fees				10	4	0			
Less : Attendants	3	12	0						
Fixing of Barricades	1	9	4						
				5	1	4			
							5	2	8
Sale of Catalogues, Plans and Photographs							6	7	2
Bank Interest							10	4	0
Gate Money							247	10	1
Interest on £918 8s. 9d. India 3% Stock, less Income Tax							25	19	0
Sale of Wood							0	5	0
Keys supplied for Bowling Green Hut							0	5	0
Hire of Tent and Tables				4	5	6			
Less : Cost of Repairs, Carriage, Fixing, etc.				3	8	1			
							0	17	5
							1473	15	8
Excess of Expenditure over Income							172	16	6
							1646	12	2
Balance in hands of the Treasurer, 31st December, 1910							228	3	1
							£228	3	1

Examined and found correct,

PHILIP L. NEWMAN. EDWIN GRAY,

11th Feb., 1911. *Hon. Treasurer.*

PHILOSOPHICAL SOCIETY FOR YEAR ENDING 31ST DEC., 1910.

EXPENDITURE. Cr.

	£ s. d.	£ s. d.	£ s. d.
Crown Rent			1 0 0
Corporation Rent			18 19 7
Rates and Taxes:			
Property Tax and City Rates		45 14 3	
Waterworks Company's Rate		11 6 0	
Gardeners' Licenses		2 5 0	
Receipt and Cheque Books Stamping ...		2 1 6	
			61 6 9
Insurance:			
Fire Premium		7 5 0	
Employers' Liability Premium		2 7 0	
			9 12 0
Salaries and Wages:			
Museums		335 15 0	
Lodge and Gardens		304 10 7	
			640 5 7
*Yorkshire Insurance Company Ltd., Annuity...			449 7 9
General Additions, Repairs, and Expenses:			
Museums		21 16 5	
Gardens		63 9 5	
Estate: Ordinary General Repairs	34 3 0		
Preservation of Ruins	51 0 6		
Repairs to Greenhouses	80 4 5		
		165 7 11	
			250 13 9
Library—Books and Binding			10 1 2
Lectures			48 14 5
Printing and Stationery			8 2 0
Printing Communications to Members and Postage of same			6 2 8
Printing Reports and Postage thereof			23 7 3
Printing Plans for Sale			3 18 0
Gas, Coal, and Coke:			
Museums		45 0 11	
Gardens		15 4 5	
Estate		21 13 9	
			81 19 1
Antiquities, Coins and Pottery			22 0 10
Sundry Postages			10 7 7
Sundries			0 13 9
			£1646 12 2

	£ s. d.
Balance in hands of the Treasurer, 31st December, 1909	400 19 7
Excess of Expenditure over Income, 1910	172 16 6
	£228 3 1

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* Annuity payable until October, 1914, inclusive, created to repay an advance of £3500 made by the Yorkshire Insurance Co. Ltd.

	£ s. d.
Principal repaid	3012 8 4
„ outstanding	487 11 8
	£3500 0 0

Memo: By an additional payment of £250, being the amount of Legacy received from the late Henry Cowling, the annual payment is reduced from £201 8s. 0d. to £133 2s. 6d.

THE TREASURER'S ACCOUNT IN CONNECTION WITH THE FUND FOUNDED BY THE LATE WM. REED, ESQ., FOR SPECIFIC PURPOSES.

Dr. INCOME.	£	s.	d.	EXPENDITURE. Cr.	£	s.	d.
Interest on £600 York Corporation 3% Redeemable Stock, less Income Tax	16	19	0	Books and Binding	18	4	0
Interest on £50 placed on Deposit with the London Joint Stock Bank Ltd.	1	5	0				
	£18	4	0		£18	4	0

BALANCE SHEET.

	£	s.	d.		£	s.	d.
Amount of Fund on 31st December, 1910	687	19	2	Amount invested in York Corporation 3% Redeemable Stock	600	0	0
				Amount placed on Deposit with the London Joint Stock Bank Ltd.	50	0	0
				Cash at Bankers in General Account	37	19	2
	£687	19	2		£687	19	2

11th February, 1911.

Examined and found correct,
PHILIP L. NEWMAN.

EDWIN GRAY, *Hon. Treasurer.*

NEW MEMBERS ELECTED, 1910.

Barton, Percy Jas., 35, Queen Anne's Road.
Beale, C. V., 6, Queen Anne's Road.
Beckwith, Dempsey, 25a, Coney Street.
Burleigh, A. B., 45, The Mount.
Challenger, W. H. F., 39, North Parade.
Colton-Fox, Mrs. M. B., Gate Fulford Hall.
Crombie, Fred R., 4, New Walk Terrace.
Crombie, Norman T., 22, Bootham Crescent.
Cudworth, Mrs., Butts Close, Tadcaster Road.
Grenside, T. R., 22, St. Olave's Road.
Hall, J. R. Clark, 35, Baskerville Road, Wandsworth Common, London, S.W.
Holliday, Mrs., Museum Street.
Horsley, Thos., Coney Street.
Hoyland, Clement E., Brierley Gap, Barnsley.
Hurworth, Wilfred, Petergate.
Jackman, Dr. C. Howard, " Westfield," Heworth.
Longman, Hy. Kerr, " West House," South Bank Road.
McIntosh, Miss M. R., 1, Sycamore Terrace.
McNalty, Capt., 2, Duncombe Place.
Milburn, Benedict C., 31, Heworth Green.
Morley, Frank, 30, Queen Anne's Road.
Mozley, Capt. E. M., Ordnance Survey Office.
Parkes, J., 6, Bootham Terrace.
Perkins, Rev. F. L., The Rectory, Monkgate.
Pottage, T. W., Fulford.
Walker, Edgar G., 17, Little Stonegate.
Walker, Edwd. H., 76, Bootham.
Wilson, R. P., Black Swan Hotel.

NEW LADY SUBSCRIBERS.

Brigham, Miss, Church View, Maryate.
Cattley, Miss, 2, Duncombe Place.
Derby, Miss C. A., 37, St. Mary's.

Olley, Miss, 23, Queen Anne's Road.
Rowntree, Miss Emily, 37, St. Mary's.
Salsbury, Miss R. A., Girls' Certified Industrial School.

NEW ASSOCIATES.

Clark, E. F., 2, Walker Street, Marygate.

DEATHS.

Members.

Agar, W. T., Brockfield.
Arlidge, Miss, St. Stephen's Orphanage.
Noble, T. S., Sycamore Villas.
Rawling, Thos., St. Andrewgate.
Strickland, Sir C., Hildenley, Malton.
Teasdale, J., Lendal.
Tennant, Hy., Holgate Hill.

Lady Subscribers.

Ditmas, Miss, 3, St. Mary's.

RESIGNATIONS.

Members, 28. Lady Subscribers, 7. Associates, 2.

DONATIONS TO MUSEUM AND LIBRARY.

LIBRARY.

Books presented.	Donor.
The Quarterly Journal of the Geological Society of London, Vol. lxvi., 1910.	The Society.
Transactions of the Royal Society of Edinburgh, Vols. xxxv., xxxvi., xxxvii. Parts 1 and 2. Vol. xlvii., Part 1. Proceedings, Vol. xxx., Parts 1 to 6.	
The Proceedings of the Royal Society, Series A., Vol. lxxxiii., Nos. A, 562, 563, 564. Vol. lxxxiv., Nos. A, 565, 566, 567, 571, 572. Series B., Vol. lxxxii., Nos. B, 553, 554, 555, 556, 557, 558, 559, 560. Vol. lxxxiii., Nos. B, 561, 562.	The Rev. Professor T. G. Bonney.
Transactions of the Zoological Society of London, Vol. xiv., Parts 2 and 3. Proceedings for 1910.	The Society.
Catalogue of Cretaceous Bryozoa, Vol. ii. Hand List of Birds, Vol. v. Memorials of Chas. Darwin. Catalogue of Lepidoptera Phalænæ, Vol ix. Guides to the Crustacea, the British Vertebrates and the Morley Catalogue of Chalcididæ.	The Trustees British Museum.
Transactions of the Linnean Society of London "Zoology," Vol. xiii., Parts 1, 2 and 4. Vol. xiv., Part 1. Journal, Vol. xxx., Nos. 201 and 202. Vol. xxxix., "Botany," No. 272.	Dr. Tempest Anderson.

The United States Geological Survey, Mineral Resources, Vols. 1, 2. Professional Papers, Nos. 65 and 68. Water Supply Papers, Nos. 227, 233, 236, 237, 238, 239, 240, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252. Bulletin Nos. 386, 390, 391, 396, 397, 398, 400, 404 to 428 and 432, and 30th Annual Report of the Director.	The United States Geological Survey.
Memoirs of the Geological Survey of India "Palæontologia Indica," Series xv., Vol. iv. Series xvi., Vol. vi., Nos. 1 and 2. New Series, Vol. ii., No. 5., Vol. iii., No. 1. Memoirs, Vols. xxxvii., xxxviii., xxxix. Survey Records, Vol. xxxvii., Parts 1, 2, 3. Vol. xxxviii., Part iv. and Vol. xxxix.	The Indian Survey.
The Report of the British Association for the Advancement of Science, Winnipeg, 1909.	The Association.
The Report of the Australasian Association for the Advancement of Science, Vol. xii.	The Association.
Annual Report of the Smithsonian Institution for 1908.	The Institution.
Bulletin of the Bureau of American Ethnology, Nos. 37, 38, 39, 45, and List of Publications with Index to Authors and Titles.	The Bureau.
Memoirs of the Russian Geological Society, New Series, No. 40 and 51. Bulletin, Vol. xxviii., Nos. 1 to 8.	The Society.
Proceedings of the Russian Mineralogical Society, No. 8, 1908.	The Society.
Proceedings of the Russian *Zoological* Society, Vol. xx., No. 4; Vol. xxi., No. 1.	The Society.

Memoirs of the Kieff Society of Naturalists, Vol. xxi., No. 2.	The Society.
An Account of the Crustacea of Norway, Vol. v., Parts 27, 28, 29, 30, by Professor G. O. Sars.	The Author.
The Bulletin of the American Geographical Society, Vol. xli., No. 12; Vol. xlii., Nos. 1 to 11.	The Society.
Memoirs and Proceedings of the Manchester Literary and Philosophical Society, Vol. 54, Parts 1, 2, 3.	The Society.
Proceedings of the Geologists' Association, Vol. xxi., Part 9.	The Association.
Bulletin of the Geological Institution of Mexico, No. 25. Text and Plates 2 parts, and Vol. iii., Nos. 4 and 5.	The Institution.
Transactions of the Leicester Literary and Philosophical Society, Vol. xiv., Parts 1 and 2.	The Society.
Transactions of the Northumberland, Durham, and Newcastle-upon-Tyne Natural History Society, Vol. viii., Part 11.	The Society.
Transactions of the Perthshire Society of Natural Science, Vol. v., Part 1.	The Society.
The Journal of the Manchester Geographical Society, Vol. xxv., Parts 1, 2, 3, 4.	The Society.
The 20th Report of the Missouri Botanic Garden, 1909.	The Committee.
The Journal of the Natural History Society of Glasgow, Vol. ii., Nos. 1, 2, 3, 4.	The Society.
Annals of the New York Academy of Sciences, Vol. xix., Parts 1, 2, 3.	The Academy.

Proceedings of the Liverpool Geological Association, New Series, No. 5.	The Association.
Proceedings and Transactions of the Croydon Natural History Society and Field Club, 1908-9, 1909-10.	The Society.
Journal of the Northants Natural History Society and Field Club, Vol. xv. Nos. 117, 118, 119, 120.	The Society.
Det Kongelige Norske Videnskabers Selskabs Skifter, 1904-1906, 2 Vols. 1906-7, 1907-10, Oversigt over Det Kongelige Danske Forhandlinger, 1901 to 1910.	The Society.
Verhandlungen der Naturforschenden Gesellschaft in Basel, Vol. xx., No. 3, Vol. xxi., No. 6. Bericht der Oberhessischen Gessellschaft für Natur- und Heilkunde zu Giessen, 3 parts.	The Society.
Mitteilungen des Vereins für Erdkunde zu Leipzic for 1908-9.	The Society.
Bergens Museums, Aarbog, for 1909-10.	The Institution.
The University Geological Survey of Upsala, Vols. ix. and x., and Index, Vols. i. to x.	The Society.
The University Geological Survey of Kansas, Vol. ix. and Bulletin of Science, Vol. v., Nos. 1 to 11.	The University.
Annalen des K. K. Naturhistorischen Hofmuseums, 1909.	The University.
Memoir of the Geological Survey of Canada, Vol. iii., No. 3.	The Survey.
Records of the Geological Survey of New South Wales, Vol. ix., Part 1, and Annual Report of the Department of Mines, and Report of the Trustees of Museums, 1910.	The Survey.

Proceedings and Transactions of the Nova Scotian Institute of Science, Vol. xii., Part 2.	The Institution.
Anales del Museo Nacional de Montevideo, Vol. vii., No. 4.	The Society.
Parergones del Instituto Geologico de Mexico, Vol. iii., No. 3.	The Society.
Memoirs of the Department of Agriculture in India, Vol. i., Nos. 8, 9; Vol. ii., Nos. 8, 9; Vol. iii., Nos. 1, 2, 3, 5; Journal Vol. v., Parts 1, 2, 3, 4, and Report of Progress.	The Society.
Fifth Annual Report of the Meteorological Committee for the year ending 31st March, 1910; Meteorological Observations at Stations of the 2nd Order for the year 1907, and weekly Weather Reports for 1910.	The Meteorological Society.
Bulletin of the Illinois State Geological Survey, Nos. 10, 12, 13, 14.	The Survey.
Report of the United States National Museum for 1909.	The Museum.
University of Toronto Studies, Nos. 6, 7, 8, 32, 33, 34, 35, 86, 87, 88, 89.	The University.
Proceedings and Report of the Ashmolean Society of Natural History for 1909.	The Society.
Museum Handbooks of the Manchester Museum, Nos. 67, 68, 69.	The Museum.
Hull Museum Publications, Nos. 68, 69, 70, 71, 72, 73, 75; Guide to the Hull Museum Bird Collection, and Guide to the Wilberforce Museum.	The Curator.
Bolletin del Cuerpo de Ingenieros de Minas del Peru for 1910.	The Engineers.

Proceedings of the Liverpool Geological Association. New Series, No. 4.	The Association.
Bulletin of the Lloyd Library, Nos. 12, 13.	The Library.
Mycological Notes, Nos. 30, 31, 32, 33, 34, 35, and Index to Vol. ii.	The Society.
Oxide of Zinc: its Nature Properties and Uses, by J. Cruickshanks Smith.	The Publisher.
Bulletin of the New York Public Library for 1910.	The Library.
Proceedings of the University of Upsala for 1910.	The University.
Reports of the American Library of Congress, 1901-1908.	The Library.
The 15th Annual Report of the Moss Exchange Club, 1910.	W. Ingham, B.A.
Report of the Bristol Museum and Art Gallery.	The Curator.
Annual Report of the Medical Officer of Health of York, 1909.	The Medical Officer.
Journal of the Torquay Natural History Society, Vol. i., No. 2.	The Society.
Reports of the Dublin Institution of Science and Art for 1907-8, 1908-9.	The Institution.
Catalogue of Antiquities in the Norwich Castle Museum and Annual Reports.	The Committee.
Report and Proceedings of the Belfast Natural History and Philosophical Society, 1910.	The Society.
Tuft's College Studies, Vol. iii., No. 1.	The College.
Calendar of the University of Leeds for 1910-11.	The University.

ZOOLOGY AND COMPARATIVE ANATOMY.

A Sturgeon mounted, and a live male Silver Pheasant.	Mr. W. Cooper.
A live male Common Pheasant.	Mr. J. Melrose.
A live Temminck's Tragopon.	Mr. W. H. St. Quintin.
Some British Finches and a Clutch of Eggs of Common Grouse.	Mr. Zimmerman.
Live male Lady Amherst Pheasant.	Mr. Oxley Grabham.
A small cabinet of Insects and an Australian Snake (mounted).	Mr. G. St. M. Palmes.
Large Egg of Aylesbury Duck.	Dr. Burtt.

ANTIQUITIES.

An old lead Tobacco Jar and Bone Pins.	Dr. Anderson.
Old Thermometers.	Meteorological Director
An old Candle Box.	Mrs. Bland.
A Water-colour Paintng of the Water Tower and Ferry, Lendal.	Mrs. Hawkswell.
A fine collection of worked Flints from Fulford, York, and a few foreign.	Captain Key, junr.
Old Certificate: Mr. Robinson, Music Master, to Princess Victoria.	Dr. Northcote.
A Styca.	Mr. J. W. M. Mason.
Six old Manuscripts relating to Land at Bellarby, 1437 to 1578.	Mr. H. G. Brigham.
A few English and Foreign Coins.	Mrs. Yarker.
A few Coins.	Mr. T. Gray.

MINERALOGY.

Specimen of Celestine, from Yate.	Mr. W. Whitaker.
A fine Collection of Polished Gems and Stones.	Mr. Max Ailion.
A few Flint Nodules.	Mrs. Palmes.

BOTANY.

An Aloe and Vase.	Mr. A. Dove.
Two pots of Orchids, *Cœlogyne*.	Mr. J. Melrose.

DESCRIPTION OF THE COINS OF EDWARD THE CONFESSOR

IN THE COLLECTION OF THE

YORKSHIRE PHILOSOPHICAL SOCIETY,

By Charles Wakefield,

Hon. Curator, Numismatics, and Hon. Curator, Archæology.

UPON the death of Harthacnut in 1041 the succession reverted to the old line and Edward III., King of the Anglo-Saxons, the surviving son of Æthelred II. and Emma, daughter of Richard I. of Normandy, ascended the throne; Edward had lived from his youth in exile at the Court of Normandy. It is said that "a halo of tenderness spread in aftertime round this last King of the old English stock; and legends told of his pious simplicity, his blitheness and gentleness of mood, the holiness that gained him his name of 'Confessor' and enshrined him as a Saint in his abbey-church at Westminster."*

His weak character and his feeble interest in worldly matters caused the real government of the kingdom during his reign to be placed almost entirely in the hands of favourites, notably Godwine and his son Harold. "Godwine is memorable in our history as the first English statesman who was neither king nor priest. Of obscure origin, his ability had raised him high in the royal favour. Shrewd, eloquent, an active administrator, Godwine united vigilance, industry, and caution with a singular dexterity in the management of men," but it is to his son Harold, Earl of East Anglia, that we probably owe the large increase in our coinage. "Harold came to power unfettered by the obstacles which had beset his father, and he was for twelve years the actual governor of the realm. The courage, the ability, the genius for administration, the ambition and subtlety of Godwine were found in his son. In the internal government of England, he followed out his father's policy while avoiding its excesses. Peace was preserved, justice administered, and the realm increased in wealth and prosperity. Its gold work and embroidery became famous in the markets of Flanders and France."

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*J. R. Green. "A Short History of the English People, 1892," p. 128, et seq.

Edward's coins are exceedingly various in type, there being, according to Akerman,* upwards of five hundred varieties, which is not surprising when we remember that the number of moneyers in his reign had increased to over 460. In the previous reign, that of Harthacnut, they numbered about 120, while in that of Harold I. there were over 230.

Concerning the exact state of the moneyers we are left without precise information on the subject, although an extract from the laws of Æthelstan seems to point the moneyer out as the actual fabricator of the coin. At any rate he must have been at the smithy to superintend its fabrication, for if the coin were debased, he was to be punished by having his hand cut off and stuck up 'over the mint-smithy.' We are also without precise information as to the manner in which the various mints throughout the country were provided with dies for striking coins. From a passage in 'Domesday,' "it appears that the moneyers received dies, and it is implied that they had to go somewhere (generally to London) to get them. In later times, at all events from Henry II. downwards, the supplying of dies appears to have rested with the Exchequer, even in the case of those which were used at the London mint, but it has been thought by some that workmen provided with patterns were sent to the various towns. But even if the types were supplied in this manner, there can be little doubt that the process by which the names of the moneyers were finally transferred to the dies was in the hands of unlettered people, who were capable of almost any kind of mistake in copying any inscription, and this accounts probably for the large number of errors placed before them in the spelling of the names of the Sovereign and of his moneyers in the following list. It does not affect the question whether these engravers were placing their own names upon the pieces or not; because, even if they were doing so, we must suppose them incapable of signing their own names and ignorant of the value of the letters which expressed them. If, as is most probable, the great earls and thanes would have been unable to sign their names below a charter, it is not likely that an obscure coin-engraver in York or Exeter would have been able to sign his name upon a coin. It therefore follows that the errors in the proper names would arise from the mistakes which the engravers made in copying the inscriptions through ignorance of the phoenetic value of the signs set before them."

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*Akerman, Numismatic Chronicle for 1840.

†British Museum Catalogue of Anglo-Saxon Coins, 1892, p. xcviii. et seq.

For the privilege of coining in those days it is thought that the moneyer paid a sum of money down, if so, he was without doubt a person whose position enabled him to put money in circulation; he would be in something of the position of the tradesmen who issued copper tokens when the coinage was scarce towards the latter half of the reign of George III., or still more like the earliest issuers of a token copper coinage in England, such as John, Lord Harrington, in the reign of James I.

The halfpence and farthings were formed by cutting the pennies into two or four pieces.

In the following list the Saxon P is always used for the W. The 174 specimens described formed part of a small hoard said to have been found on Bishophill, they are in a beautiful condition, and apparently have never been in circulation; they are arranged according to Hawkins.*

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*Edward Hawkins. "The Silver Coins of England," 3rd Edition, 1887, p. 160, et seq.

DESCRIPTION OF TYPES.

<table>
<tr><th>OBVERSE.</th><th>REVERSE.</th></tr>
<tr><td colspan="2"><i>Type VI. Fig.</i> 1.</td></tr>
<tr><td>King's bust to the right; wearing crown of two arches, surmounted by three balls; in front, sceptre.</td><td>Short cross voided, each limb terminating in an incurved segment of a circle, in centre a pellet. Around, inscription; outer circle.</td></tr>
<tr><td colspan="2">(Cf. Hks. plate XVII., fig. 222).</td></tr>
<tr><td colspan="2"><i>Type VI., var. a. Fig.</i> 2.</td></tr>
<tr><td>Same.</td><td>Similar; annulet in one angle of the cross.</td></tr>
<tr><td colspan="2"><i>Type IX. Fig.</i> 3.</td></tr>
<tr><td>King's bust to the right wearing arched crown with pendant terminating in three pellets hanging down at the side; in front, sceptre. Around, inscription divided by bust; outer circle.</td><td>Short cross voided; annulet or pellet frequently in centre; in each angle a pyramid springing from inner circle and terminating in a pellet. Around, inscription between two circles.</td></tr>
<tr><td colspan="2">(Cf. Hks. plate XVII., fig. 223).</td></tr>
<tr><td colspan="2"><i>Type IX., var. a. Fig.</i> 4.</td></tr>
<tr><td>Same.</td><td>Similar; annulet instead of a pyramid in one angle of the cross.</td></tr>
<tr><td colspan="2"><i>Type XIII. Fig.</i> 5.</td></tr>
<tr><td>King's bust facing, bearded, wearing arched crown frequently surmounted by cross. Around, inscription between two circles continued beneath the bust.</td><td>Small cross pattée. Around, inscription between two circles.</td></tr>
<tr><td colspan="2">(Cf. Hks. plate XVII., fig. 225).</td></tr>
</table>

<table>
<tr><th>OBVERSE.</th><th>REVERSE.</th></tr>
<tr><td colspan="2"><i>Type XIII., var. a. Fig.</i> 6.</td></tr>
<tr><td>Same.</td><td>Similar ; annulet in field.</td></tr>
<tr><td colspan="2"><i>Type XIII., var. b. Fig.</i> 7.</td></tr>
<tr><td>Similar, but more rounded face, bearded.</td><td>Same.</td></tr>
<tr><td colspan="2"><i>Type XVI. Fig.</i> 8.</td></tr>
<tr><td>King's bust to right, bearded, mitred, sceptre in hand, terminating in a cross, three pellets, or fleur-de-lys. Around, inscription divided by bust ; outer circle.</td><td>Short cross voided, each limb terminating in three crescents; in centre, annulet frequently enclosing a pellet.</td></tr>
<tr><td colspan="2">(Cf. Hks. plate XVII., fig. 227).</td></tr>
<tr><td colspan="2"><i>Type XVI., var. a. Fig.</i> 9.</td></tr>
<tr><td>Same.</td><td>Similar ; annulet in one angle of cross.</td></tr>
<tr><td colspan="2"><i>Type XIX. Fig.</i> 10.</td></tr>
<tr><td>King seated towards the right on throne, generally but not always bearded, wearing crown surmounted by three balls ; he holds in his right hand a long sceptre and in his left hand an orb surmounted by a cross, Around, inscription ; outer circle.</td><td>Short cross voided; annulet or pellet frequently in centre ; in each angle a martlet. Around, inscription between two circles.</td></tr>
<tr><td colspan="2">(Cf. Hks. plate XVII., fig. 228).</td></tr>
<tr><td colspan="2"><i>Type XIX., var. a. Fig.</i> 11.</td></tr>
<tr><td>Same.</td><td>Similar. Annulet in two angles of the cross.</td></tr>
</table>

DESCRIPTION OF COINS

No.	Obverse.	Reverse.	Weight.	Moneyer.
		EOFERPIC (York) TYPE VI, VAR. A		
1	+ EDPΛ·RD REX	+ ΛRCETL ON EOFRP	19.3 grs.	Arcetl (= Arncetel?)
2	+ EDPΛER· DR	+ ΛRNCTEL ON EOFR	19.0	Arnctel (= Arncetel?).
3	+ EΛDPR DRE	+ ΛRNGIN » »	20.0	Arngin (= Arngrim?).
4	+ EDPΛR »	+ ΛRNGRIM ON EOFER	20.0	Arngrim.
5	» »	» » »	20.0	»
6	+ EDPΛR·	» » »	20.0	»
7	»	» » EOFR	19.0	»
8	+ EΛDPR DRE	» » »	20.0	»
9	+ EDPΛR· DRE·	+ IOCITEL ON EOFER	20.5	Iocitel.
10	+ EΛDPΛ· RDRE	+ IOCTEL ON EOFR	21.0	Ioctel (= Iocitel?).
11	+ EΛDPΛR DRE	+ IOLΛ ON EOFERICE·	21.0	Iola.
12	+ EDPΛER· DRX	+ OÐBERN ON EOFR	20.0	Ođbern.
13	+ EΛDPRD DRE	+ OÐBORN ON EOF	20.5	»
14	+ EDPΛER DRX	» » EOFR	19.0	»
15	+ EDPΛR DRE	+ OÐGRIM ON EOFER	17.0	Ođgrim.
16	+ EΛDPΛ RDR	+ » » EOFRP	22.0	»

17	+ EADPAR· DRE	+ S CVLAE ON EOFRI	19.0	Scula.
18	» »	» » »	19.0	»
19	+ EADPAR DRE·	+ » » EOFRPI	20.5	»
20	+ EDPARD REX	+ SCVLA ON EOFER·	18.0	»
21	» »	+ » » EOFERP	16.5	»
22	+ EADPAR DRE·	+ » » EOFERPIC	17.0	»
23	+ EDPAR DRE	+ SNEBORN ON EOF	22.2	Snaebern.
24	» »	» » »	20.5	»
25	+ EDPAR· DRE·	+ » » EOFER	19.5	»
26	» »	» » »	20.0	»
27	+ EDPAR DRE	+ SNEBRN ON EOFRP	20.5	»
28	» »	» » »	21.2	»
29	+ EDPAR DRE·	+ SPA·RTCOL ON EO	19.5	Swartcol.
30	+ EADPA RDR	+ VLFCEL ONEOÐE	21.5	Ulfcel (= Ulfcetel?).
31	+ EADPAR DRE	+ VLFCIL ON EOFERP	21.5	Ulfcil (= Ulfcetel?).
32	+ EDPARD REX	+ VLFCTEL ON EOFER	17.5	Ulfctel (= Ulfcetel?).
33	+ EDPARI DRE	+ » » EOFR	19.7	»
34	+ EDPARD DRE·	+ » » EOFRP	17.2	»
35	» »	+ ÐORR ON EOFERP	16.5	Porr.
36	+ EDPARI DRE	» » »	21.0	»
37	» »	+ » » EOFERPI	21.7	»
38	+ EDPARD DRE·	+ » » EOFERPIC	18.0	»
39	» »	» » »	19.5	»
40	+ EDPAR DRE	+ » » EOFRPI	21.5	»
		TYPE IX, VAR. A		
41	EADPARD REX :	+ AL·EIF ON EOFERPI	18.2	Aleif (= Aleof?).
42	» REX	+ » » EOFRPICC	20.2	»
43	» »	» » »	21.2	»
44	» REX :	+ AL·EOF ON EOFERP	21.2	»

No.	Obverse.	Reverse.	Weight.	Moneyer.
45	EΛDPΛRD REX	+ ΛRCTEL ON EOFER	20.5 grs.	Arctel (= Arncetel ?).
46	» REX :	+ EΛRCIL ON EOFERP :	20.5	»
47	» REX	» » »	21.2	»
48	» »	» » EOFRPIC	21.2	»
49	» »	» » »	21.7	»
50	» »	+ IOCCETEL ON EOFE	21.0	Ioccetel (= Iocitel?).
51	» »	+ IOCETL ON EOFRPIC	18.5	Iocetl (= Iocitel?).
52	» »	+ OVÐBORN ON EOFR	21.2	Oudbern.
53	EDRRDE »	+ OVÐϭRIM ON EOF	22.5	Oudgrim.
54	EΛDPΛRD »	» » EOFR	20.3	»
55	» RX	+ OVÐOIF ON EOFER	21.2	Oudoif.
56	» REX	+ OÐBORN ON EOFRR	22.0	Ođborn (= Othbern?).
57	» »	» » »	20.5	»
58	» »	+ SCVLΛ ON EOFERPI	21.0	Scula.
59	» RX	+ SENEBRN ON EOFR	20.5	Senebrn (= Snaborn?).
60	» REX	+ SNEBRN ON EOFRPIC	22.5	Snebrn (= Snaborn?).
61	» »	» » »	21.2	»
62	» »	+ VLFCETEL ON EOFE	19.5	Ulfcetel.
63	» RX	+ VLFCETL ON EOFER	20.2	»
64	» »	» » »	22.0	»
65	» REX	+ ÐOR ON EOFERPIC :	24.5	Þorr.
66	» »	+ ÐORR ON EOFRI	22.0	»
67	» »	+ » » EOFRPIEC	22.0	»
68	» »	» » »	22.0	»
		TYPE XIII, VAR. A		
69	·EΛDPΛRD REXΛ·	+ ΛRCÉL ON EOFERPI	18.5	Arcel (= Arncetel ?).

70	» RXΛNC·	» » »	14.0	»
71	» REXΛ·	+ ΛRCIL ON EOFRPI	11.0	Arcil (= Arncetel ?).
72	» »	+ ΛRNCTEL ON EOFR	15.2	Arnctel (= Arncetel ?).
73	» »	+ IOCETEL ON EOR·	14.0	Iocitel.
74	» »	+ IOCTEL ON EOFRP	15.5	Ioctel (Iocitel ?)
75	» »	+ OVÐOLF ON EOFER	16.3	Ouđolf.
76	EΛDPΛRD REXΛI	+ OÐBEORN ON EOFR	14.5	Ođbeorn (= Othbern).
77	» »	» » »	14.2	»
78	» »	+ OÐBERN » »	13.5	Ođbern.
79	·EΛDPΛRD REX·	+ OÐCRIM ON EOF	18.0	Ođgrim.
80	» REXΛ·	» » EOFR·	13.0	»
81	» REXΛH·	» » EOFRP	16.2	»
82	·EDPΛRD REXΛN·	+ OÐOLF ON EOFER	15.3	Ođolf.
83	EΛDPΛRD REXΛI	» » »	15.3	»
84	·EΛDPΛRD REXΛ·	+ SCVLΛ ON EOF	14.5	Scula.
85	» »	» » EOFER	16.0	»
86	» »	» » EOFRPI	17.2	»
87	» »	+ SNEBORN ON EOFR	17.2	Sneborn (= Snaebern).
88	·EΛDPΛRD REXΛ·	+ SPΛRTCOL ON EΘ	13.7	Swartcol.
89	» »	» ON EOFR	14.5	»
90	» REX	+ SPRTCOL ONEOFR	14.0	Swrtcol (=Swartcol ?).
91	» REXΛ·	+ VLFCIL ON EOFER·	15.6	Ulfcil (= Ulfcetel ?).
92	» »	+ VLFCTEL ON EOF	15.0	Ulfctel (= Ulfcetel ?).
93	EΛDPΛRD REXΛI·	» » EOFR	16.0	»
94	·EΛDPΛRD REX·	+ ÐORR ON EOFERP	14.7	Þorr.
95	» REXΛN·	» » EOFERRP	14.7	»
96	» » Λ·	» » EOFR	15.0	»
97	» »	» » EOFR·	19.5	»
98	» REXΛN·	» » EOFRP	16.8	»
99	» »	» » »	17.0	»

No.	Obverse.	Reverse.	Weight.	Moneyer.
		TYPE XIII, var. b		
100	+ EDPΛRDE REX	+ ΛRCEL ON EOFRP·	16.5 grs.	Arcel (= Arncetel ?).
101	» »	» » »	16.2	»
102	» »	» » EOFRRPI	17.2	»
103	» »	+ ΛRCIL ON EOFERI	14.5	Arcil (= Arncetel ?).
104	+ EΛDPΛRD RE·	+ ΛRGRIM ON EOF·	17.5	Argrim (= Arngrim ?).
105	+ EΛDPΛRDE /REX	+ ΛRNCTEL ON EO	16.5	Arnctel (= Arncetel ?).
106	+ EΛDPΛRED RE	+ ΛRNGRIM ON E·	17.5	Arngrim.
107	+ EΛDPΛRD »	» » EOI	16.8	»
108	» »	+ OVÐOLF ON EOFER	15.3	Ouđolf.
109	·EDPΛRD RE++·	+ OÐBEN ON EOFRI	16.0	Ođben (= Othbern ?).
110	» REXΛNG·	+ OÐBOREN ON EO	17.5	Ođboren (= Othbern ?).
111	» » »	+ ODBRN ON EOFRP	17.5	Ođbern (= Othbern ?).
112	+ EΛDPΛRD REX	+ OÐϭRIM « «	17.3	Ođgrim.
113	+ EDPΛRDE »	+ SCVLΛ ON EOF	15.8	Scula.
114	» REX·	» » EOFERP	15.8	»
115	+ EDPΛRED REHX	+ SNÆBORN ON EOF	16.5	Snæborn (= Snæbern ?).
116	» »	+ SNEBORN ON EO	16.0	Sneborn (= Snæbern ?).
117	» »	» » »	16.8	»
118	+ ΛDPΛRED REHX	+ » » EOFR	16.0	»
119	+ EDPΛRDE REXΛ	+ SPΛRTCOL ON EOF	17.0	Swartcol.
120	·EΛDPΛRD REXΛN·	+ SPRTCOL ON ONEOFRI	15.8	Swrtcol (= Swartcol ?).
121	+ EΛDPΛRD RE ·	+ VLFCTEL ON EOFR	16.2	Ulfctel (Ulfcetel ?).
122	» »	» » »	15.2	»
123	» »	+ » » ONEOR	17.0	»
124	+ EDPΛERD REX	+ ÐORR ON EOFERPI	17.0	Þorr.

125	» »	» » »	17.5	»
126	» »	+ » » EOFRPIC	17.8	»

TYPE XVI, VAR. A.

127	+ EDPΛR· DRE	+ ·ĀRNCEL ON EOFER·	20.5	Arncel (= Arncetel ?).
128	+ EDPΛ ·RDR·	+ ΛRNϭRIM ON EOFER	19.8	Arngrim.
129	+ EDPΛR DRE·	» » EOFR·	19.8	»
130	+ EDP RDE·.·	+ ΛRNGRIM ON EOFRPIC	21.0	»
131	+ EDPERD REX··	+ FEOFENOÐ ON EOFR	20.5	Feofenođ (= Feofenoth?).
132	+ EDPE DREX	+ IOCIL ON EOFERPIC	20.0	Iocil (= Iocitel?).
133	+ EDPΛR· DRE·	+ IOL·E ON EOFERPICCE	21.5	Iole (= Iola ?).
134	+ EDPERD REX··	+ LEOFENOÐ ON EOFE	21.2	Leofenođ (= Leofenoth?).
135	+ EDPER·.· DRX	+ RAFEN ON EOFERPICE	20.5	Rafen.
136	+ EDPΛR· DR·	+ SCVLE ON EOFERICE	21.2	Scule (= Scula ?).
137	+ EDPΛR ·RX·	+ SPARTCOL ON EOFR	20.8	Swartcol.
138	+ EDPERD· REX·	+ VLFCEETEL ON EOF	24.2	Ulfceetel (= Ulfcetel ?).
139	+ EDPΛ· RDRI·	» » »	22.0	»
140	+ » » R·	+ VLFCETEL ON EOFR	21.2	Ulfcetel.
141	» »	» » »	16.0	»
142	+ EDPΛR· DRI·	+ PINTERFVϭL· ON EOF	21.8	Winterfugl (= Winter-fugel ?)
143	+ EDPΛ RDRX	+ ÐORR ON EOFERP	20.0	Porr.
144	+ EDPΛ· RDR·	» » EOFERPI	20.0	»

HALPPENNY

145	+ RDR	+ ÐORR ON E	10.0	Porr.
146	+ DREX	L ON EOF	9.5	»

TYPE XIX

147	EDPΛDRX ΛNϭORΛ·	+ ΛRИϭRIM OИ EOF :	21.3	Arngrim.

No.	Obverse.	Reverse.	Weight.	Moneyer.
148	EDPΛRD ΛϭLORΛ	+ IOLΛ ONN EOFERPIC·	18.0	Iola.
149	» RXΛϭLO	+ OÐCRIM ON EOFRPIC	21.0	Ođgrim.
150	» »	» » »	21.8	»
151	EΛDPΛRD REX ΛИϭL·	+ SCVLΛ OИИ EOFE·	19.3	Scula.
152	EDPΛD RX ΛϭLOR·	» ON EOFRPIC	19.3	»
153	EΛDPΛRD REX ΛИϭ·	+ SИEΛBVRИ OИ EOFE	19.8	Sneaburn (Snæbern?).
154	» » »	» » »	20.5	»
155	» » ΛИϭLO	+ VLFCETEL OИ EOF	20.3	Ulfcetel.

TYPE XIX, VAR. A.

No.	Obverse.	Reverse.	Weight.	Moneyer.
156	EDPΛD RX ΛNϭORΛ·	+ ΛRNCRIM ON EOF	19.5	Arngrim.
157	EDPΛRDXΛNϭLOR	» » EOFR	19.5	»
158	» RX »	+ LEFNOÐ ON EOFRP	17.5	Lefnođ (= Leofnoth?).
159	» X »	+ OÐCRIM ON EFRPI	18 5	Ođgrim.
160	» RXΛϭLO	» » EOFRP	21.5	»
161	E·· DPΛRD RX ΛNϭLO	+ SCVLΛ ON EOFERPIC	20.0	Scula.
162	EDPΛRD RX ΛNϭLO·	+ SNEBRN ON EOF·	21.0	Snebrn (= Snæbern?).
163	» » »	» » »	20.5	»
164	» » »	» » EOFRPI	22.0	»
165	» » »	» » »	20.8	»
166	EΛDPΛRDXΛNϭLOO	+ VLFCETEL ON EOFR	20.5	Ulfcetel.
167	EΛDPRDXΛNϭLOR	+ VLFCETL ON EOFRP	21.0	Ulftrstl (=Ulfcetel?).
168	EDPΛDX »	+ VLFETEL ON EOFRPI	19.0	Ulfctel (= Ulfcetel?).
169	EDPΛRDXΛNϭLORO	+ VLFCTELOÐEϭINC	19.0	»
170	✠ EDPERD∵REX∵	✠ VLFKEL ON EOFERP	20.2	Ulfkel (Ulfcetel?).
171	EΛDPΛRD REX ΛИϭL·	+ ÐORR OИ EOFER··	22.5	Þorr.
172	» » »	» ON EOFERPIC	20.0	»
173	» » »	» » EOFRPICC	20.0	»
174	EDPΛD RXΛNϭLOR	» » EOFRPICE	21.8	»

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Coins of Edward the Confessor.

THE

ROMAN POTTERY IN YORK MUSEUM,

By Thomas May, F.S.A. (Scot.)

(Continued.)

PART II.

II. Romano-British Wares.

Widening knowledge of Roman ceramics has shown that the use of the terms Samian, Castor, Upchurch and Salopian, as class names for the wares to which they are usually applied, should be abandoned. They have already been discarded as misleading or inadequate by the latest investigators in this country, and they are unknown to, or regarded as obsolete by Continental archæologists, whose labours have rendered a more systematic classification possible.

The recent pulications on which the following modified classification of the later and coarser descriptions of Romano-British pottery is based are the following :—

(1). Lœschcke, *Haltern*, V.—*Mitteilungen der Altertums Kommission für Westfalen*, V. (1909), III. Ausgrabungen bei Haltern. Die keramischen Funde, by S. Lœschcke.

(2). *Mitteilungen über Römische Funde in Heddernheim*, IV. (1907). 1. Das römische Gräberfeld bei Praunheim, by Prof. Dr. A. Riese. 4. Die Töpfereien vor dem Nordtore der römischen Stadt, by Prof. Dr. G. Wolff. 5. Die Fundstücke aus der römischen Töpferei vor dem Nordtore, by Director-Assist. R. Welcker.

(3). Ritterling, *Wiesbaden.—Der Obergermanisch-rætische Limes*, XXXI., No. 31, Weisbaden, by Prof. Dr. J. Ritterling (1909).

(4). Orl, XXXII., No. 8, *Zugmantel*, by Dr. Walther Barthel, (1909).

(5). Orl, XXXIII., No. 33, *Stockstadt*, by Dr. Fried. Drexel, (1910).

(6). Curle, *Newstead.—A Roman Frontier Post and its People. The Fort of Newstead in the Parish of Melrose* (1911), by James Curle, F.S.A. (Scot.), F.S.A.

They are to be regarded as additional to those already mentioned at the beginning of Part I.

The classification of Roman provincial pottery according to individual character—form, ornamentation, material and technique

—which is the prevailing one among Continental archæologists, is likewise requisite in dealing with the York collection, in order to be useful or complete. This is owing to the fact that the productions of local potteries of the Roman period in our museums are often indistinguishable, and that some of the most important centres of production in Britain are still unknown or unexplored.

The pottery finds from the Roman camp of the Augustan period at Haltern, in Westphalia, dating from B.C. 11 to A.D. 9, are arranged by Lœschcke (*Haltern* V., p. 102), under three general headings, I. Roman, II. Belgic, III. German Wares. The Roman wares in Class I. are subdivided into (1) Colour-coated,—A. Italian, (a) Terra sigillata. B. Provincial, (b) Green-glazed, (c) Mica-coated, (d) Varnished. (2) Plain clay-bodied vessels.

Italian terra sigillata found at Haltern, derived mainly from Arretine potteries, is replaced in the much later collection at York by similar wares imported from La Graufesenque, Lezoux, Rheinzabern and other potteries, as stated in parts I. and II. of this general description (Reports 1909-1910).

The green glazed vessels in Class B are unrepresented at York, and mica-coated vessels are represented by a few vessels and fragments of colour-coated goblets dusted with mica almost imperceptibly, which cannot be looked upon as constituting a separate class.

The native German wares are also entirely wanting at York.

The grey to black Belgic wares (terra nigra), made in imitation of early sigillata, most frequently copying Arretine forms, though present at Colchester and Silchester, have not been observed at York. The red variety can, however, be recognised in one or two cups and bowls with pinkish-red colour-coating imitating red sigillata (Plates V., 7, 8, VI., 18), and saucers or plates with slightly turned in rims, and low foot-rings, coated lightly with pinkish-red on the visible parts. (Belgic ware included in Class II.)

It happens that a number of vessels of smoke fumed grey-black ware, such as bottle-necked urns, carinated or angular bodied vessels, small oblique-lipped ollæ artificially roughened with raised ridges, or studded with clay knobs round the bulge, bowls with flat out-bent rims grooved or reeded on the surface, &c., in our principal museums in London, Colchester, Reading (Silchester collection), York and Edinburgh, and usually classed as Upchurch, are of similar form and technique to those described by Lœschcke as autochthonous Belgic wares, and to others frequently met with in later Romano-Belgic cemeteries. Hence it appears probable that such wares, usually termed Upchurch, would be more accurately described as Belgic or Romano-Belgic wares. According to Lœschcke (Op. cit., p. 258 ff.) autochthonous Belgic types are to be distinguished from those which are merely imitations of Roman shapes of vessels ; and only the finest Belgic crockery is specified when only terra nigra, grey, and orange-red is assigned to it. Like all other peoples the Belgæ had their cooking-pots, store-vessels, &c., prepared in coarser technique. With the abandonment of sigillata imitations (in the Claudian-Neronic period, or not later than about 68 A.D.), the native element in Belgic vessels again came more strongly forward.

The recorded evidence also makes it clear that the immense accumulation of potsherds, "mixed with plenty of vessels in a perfect or nearly pefect state,"* obtained by probing in the soft mud, in the creeks and inlets of the Medway near to Upchurch, where no potters' kilns have been found or could ever have existed, is not composed of 'wasters,' *i.e.*, overbaked, flawed, distorted or discoloured specimens, such as are invariably found in heaps around the kilns; but suggests that the accumulation is a gradual deposit through centuries of breakages during the voyage, and whole vessels dropped overboard while unloading the the flat bottomed ships in which they were imported from the opposite coasts,—a kind of deposit which is known to exist near to Tilbury Fort, higher up the River Thames. Other facts recorded, viz., that 'Upchurch wares' are equally common in France and Germany,† and that immense quantities of precisely similar wares to those found near Upchurch exist in the turf bogs of Flanders and near to Boulogne,‡ amply confirm the view that they are of Continental origin.§

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* Wright, *The Celt, the Roman and the Saxon*, p. 260.

† Archæologia, XXIX. (1842), p. 223 ff.

‡ C. R. Smith, *Collect. Antiq.*, VI., p. 198.

§ Speaking of Upchurch wares, Walters (*Cat.* li.), says "it is very unlikely that any of these varieties were manufactured there," and suggests as the only likely centre, Higham, in the neighbourhood ; but the wares actually found at Higham are much inferior to Upchurch wares.

In describing the grey to black 'smother-kiln' wares, such as those found near to Upchurch and akin to Romano-Belgic wares, the as yet unsolved problem of origin has been evaded by applying to them the term 'fumed' wares.

Lœschcke's classification, modified so far as necessary to adapt it to the York collection, becomes the following :—

I. Roman Wares—
  1. Vessels with coloured coating.
    A. Italian crockery-ware.
      (a) Terra sigillata (Arrentine).
    B. Provincial crockery-ware.
      (b) Terra sigillata (Gaulish and German).
      (c) Slip-coated and varnished wares.

  2. Plain clay-bodied vessels.
    (a) White clay vessels of fine texture.
    (b) Plain clay-bodied vessels of coarse texture.

II. Terra nigra and allied wares (Belgic, Upchurch and other fumed wares).

III. British black-grey fumed ware containing calcite or quartz particles.

The colour-coated vessels are mostly small, such as bowls, cups, goblets, beakers, unguent pots, &c.; while those of plain clay are usually of larger size, ewers, pitchers, bottles, cooking-pots (ollæ), basins, dishes, plates, and mortaria or pelves; and store vessels, such as three handled pitchers, amphoræ, dolia, &c.

The coloured wares are sub-divisible according what may be termed their secondary ornamentation into—

(1) Barbotined,
(2) Mica-dusted,
(3) Folded, fluted and indented,
(4) Rough-cast and studded,
(5) Roulette-notched (engine-turned or hatched),
(6) Grooved or incised,
(7) Scored with a fine point or combed,
(8) Painted or parti-coloured, including New Forest ware and 'face vases,'
(9) Vessels ornamented with frilled cordons,
(10) Un-ornamented.

These sub-divisions frequently overlap, since two or three kinds of ornament are often found upon the same vessel.

Plain clay vessels, especially those of early date, or with Late Celtic affinities, are rudely ornamented with cordons, thumb-markings or indentations, grooves (horizontal, vertical or oblique), patterns scored with a blunt point or combed, stabbing or punctures, roulette notching or hatching, and they are sometimes burnished on the upper portion of the body, but these incidental peculiarities are not of a distinctive character, or capable of being used to deignate a class.

The following is a brief explanation of the technique of the processes of colour-coating, compiled from the works of the authorities above quoted, and others of recent date, on which the present classification is based :—

1.—*Alkaline or true glaze.* Frit composed of clay vitrified by melting with alkali is ground to impalpable powder and mixed with finely ground red or black iron oxide in water.[*] With this solution, the vessels in biscuit state (after first firing), are coated by dipping, steeping, painting, or otherwise, and then re-fired at a temperature only sufficient to vitrify the glaze.

2.—*Red terra sigillata glaze.* The vessels are generally composed of well levigated clay containing naturally 5 or 6 per cent. of red iron oxide in a free state, and after first firing, are dipped in a slip of similar clay containing naturally or by addition 7 to 11 per cent. of hæmatite. (The addition of an alkali, such as salt or soda, to the dip, though probable, has not been proved). The vessels are then re-fired.

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[*] The colouring ingredients are the same, viz., ferric oxide or peroxide and ferro-ferric or magnetic oxide, whether added in the form of hæmatite, ochre. or 'mine' for red or brown ; or 'bull dog' (impure silicate of iron), scale, or ground iron for black or grey.

This was the glaze applied by the Greeks on their famous red and black vases, and later by the Romans on the so-called Rhenish ware, described in the preceding Report, 1910, plate VIII., No. 7, a.b.c.

An American archæologist, Oliver S. Tonks, who has published the result of his experiments in the *Journal of American Archæology*, 2 Ser., vol. XII., 1908, part 4, p. 420, states that "8 parts of nitrate of soda and 1 part of clay fritted together and mixed in the proportion of 2 parts of frit and 1 of ferrous oxide, produced a glaze identical with that on the Greek vases."

Its percentage composition from an average of Salvètat's analyses in Brongniart's *Traité des Arts Céramiques* is as follows : silica 48·15, alumina 11·90, oxide of iron 11·85, chalk 5·70, magnesia 2·30, alkali 17·10.

This is stated to be the process by which the glaze or lustre is produced on red terra sigillata or 'Samian.'

3.—*Black varnish or lustre.* Vessels of ordinary clay in biscuit state are dipped in a watery solution of 'ground iron' or 'bull-dog' (impure silicate of iron from the smelting furnaces), and re-fired; or hæmatite is used in the dip as the colouring ingredient and reduced to black iron oxide by 'fuming' at the end of the firing process.*

4.—*Facing with Hæmatite.* A process going back, in Egypt, to the earliest pre-historic period, of baking clay vessels in an open fire, mouth downwards, produces a glossy black on the inside and upper portion of the outside nearest the rim, and a soft red on the lower portion of the outside nearest the base, after they have been coated with hæmatite.†

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* Welcker, dealing with the finds of ordinary pottery from the ovens before the north gate at Heddernheim, where the potteries were at work from about A.D. 133 to A.D. 200, infers that the black colour-coating on large and small urns was obtained by entire or partial dipping previous to the second baking, the vessel being held upside down between the fingers in the solution, as shown by the marks of the latter, and the streaks which have run down on the uncoated portion of the base.

A black-brown epidermis was found on indented goblets, which had apparently been first coated with white slip and then fumed dark.

Folded goblets, unguent pots, and other vessels with bands of roulette hatching, and a metallic glistening, slightly iridescent glaze-like coating, had a rough matt surface in places where the fine coating had been driven in by excessive heat, while the glistening surface was preserved in the protected portions.

On all the examples of varnishing or slip-coating that occurred, there was the appearance of a colouring ingredient being added differing from that of the vessel. *Hedd. Mitteil,* IV., p. 118 ff.

It may be added that, in the opinion of expert chemists, the iron oxide combines with the surface of the clay body under the influence of carbonyl gas, or inappreciable quantities of salt, potash, or borax present in the fuel, to form ferro-silicate, which is a very stable compound—a sort of iron glaze or impure opaque glass. The slight iridescence observed by Welcker on some of the wasters at Heddernheim confirms this opinion.

† This is described by Prof. Flinders Petrie, *The Arts and Crafts of Ancient Egypt,* 1909, p. 130, as one of the methods employed by the ancient Egyptians of baking and colouring their pottery. The same authority furnishes the following explanation of the chemistry of the black and grey body colours, and black lustre or varnish on ordinary clay vases of the Roman period.

He says it is "probable that all black pottery is due to black oxide of iron produced by imperfect combustion. Smoke—or fine carbon dust—could not possibly penetrate through close grained pottery, and the black extends all

5.—*Matt-black colour coating.* The vessels in biscuit state are dipped into a slip or engobe consisting of impure silicate of iron in water, without any inter-mixture of clay or other ingredient, and 'fumed' or re-fired at a low heat, as in the previous instance.

The matt-black coating on vessels of so-called Castor ware appears to have been so produced.*

6. *Clay slip coating.* The vessels after drying are steeped in a thin solution (slip or engobe) of the same or a different kind of clay, and then fired in the usual manner.

Examples of handled pitchers of ordinary brick-red clay which have been coated with white-clay slip of soft texture and easily rubbed off, are often met with.

7.—'*Fuming.*' Vessels of ordinary clay containing the usual proportion, 4 to 5 per cent., of red iron oxide in a free state, which gives the clay its brown-red colour, are fumed, or heated in dense black smoke at the end of the firing process, and the clay-body thereby reduced to a uniform blue-grey colour.†

The terra nigra (Belgic), Upchurch, and other black, grey-black, and blue-grey coarse unglazed wares are fumed wares. The practice goes back to the Early Iron Age or La Tene period, and continued to be employed to the end of the II. Century A.D.

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through the mass, naturally owing to the action of reducing gases to which the pottery is quite pervious." Carbonyl gas (carbon monoxide), which is the result of imperfect combustion, has reduced the red per-oxide of iron to black magnetic oxide, such as is familiar to us in the black scale on sheet steel; carbonyl is a solvent of magnetic oxide of iron, and so dissolves and re-composes the surface facing. The iron on the hæmatite faced portions of the vessels is reduced to a brilliant mirror-like coat of black all over, except on those portions where the heat has lasted long enough for the oxygen to pass through the pottery, and the red colour of the hæmatite has been retained.

* In modern practice 'ground iron' mixed with water is used as a dip for producing grey or half grey and half red roofing tiles:—the former, after firing, are dipped completely, and the latter half-way in the solution, and are then re-fired at a lower temperature.

† The mode of production of the blue grey bricks and tiles in common use at the present day is thus explained by Mr. W. Burton, F.C.S., in a paper entitled, "The Palette of the Potter," published in *The Journal of the Society of Arts*, 28th Feby., 1896, p. 323:—"In this case a clay which would in the ordinary course burn to a full red colour, is fired in such a way that dense volumes of black smoke are turned into the oven during the last hour or two of firing, with the result that the red oxide of iron in the clay is deprived of part of its oxygen, and is converted into another oxide of iron, the magnetic oxide, which is of a purplish black colour."

In the second half of the first century, blacking by means of a glossy varnish coating came into use, and both continued to be practised on the same kind of vessels side by side till the latter prevailed.*

Early Roman pottery is characterised by neatness, regularity, and fitness of form. The profiles of the holders of large vessels are rounded to obtain the greatest capacity ; the widest diameter is at or below the middle ; the width of base is always sufficient to ensure stability.

In these respects the later productions of the period show a gradual falling off. Vessels which are known by reliable evidence to belong to the end of the fourth or beginning of the fifth century, or about the time of the Roman departure, often appear top-heavy, clumsy, or elongated to an inordinate degree. Their profiles have a strongly pronounced concavity above or below, and terminate in a ridiculously small foot.

Advantage can be taken of these peculiarities to determine approximately their relative dates. If, for example, the height, and diameters of rim, body and base of a particular type of vessel at different known dates are obtained and the percentage proportions of these diameters to the height (taken as 100), tabulated, the resulting table of proportions furnishes a standard of reference for determining approximately the date of others belonging to the same type of vessel.

The compilation of a table of standard proportions is not possible for every type of vessel made during the Roman period, but only for those produced under Roman influence and composed of separate members—rim or mouth-piece, neck, body or bulge, and base—capable of measurement, and of which the diameter is not much greater than the height, such as pitchers, flagons, bottles, flasks, ollæ or cooking pots, beakers, goblets, &c.

The graceful and fantastic fancy displayed by the Late Celtic potters in the form and ornamentation of their wares did not altogether die out, but, with the growth of provincial influence and decline of Italian supremacy, reasserted itself in the revival of certain conventional peculiarities. The markedly concave profile of the lower portion was a general feature of Late Celtic pottery which created instability, and was usually re-dressed by addition of a pedestal or expanded foot. This useful addition was not, however, restored upon the later revivals, which have an inferior holding capacity and unserviceably contracted base.

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* Dragendorff, *Bonn. Jahrb.*, XCVI., p. 87.

In preparing the following tables of standard proportions, due regard has been paid to the origin of the various types. It should also be stated that the possibility of preparing them is due to the accurate and complete dilineations of the types furnished by German archæologists, and by recent writers in this country, who have commenced to supply drawings of the principal types as well as photographs of each vessel or fragment. This applies especially to Mr. Curle's Newstead volume.

Unnecessary trouble may be avoided in preparing and referring to the tables, when only photographs and drawings of small size are available, by employment of the metric system and taking the measurements to the nearest millimetre, or half-millimetre, and by calculating the proportions with a logarithmic slide-rule.

Though many of the proportions in these tables have been obtained from small drawings and photographs on which there is always a certain amount of fore-shortening, and may require revision from direct measurements, this does not interfere with the accuracy of the comparative results. On comparison of the results for the beginning and end of the four centuries of the Roman occupation given in the last column (proportion of the base diameter to the height taken as 100), the amount of the attenuation is seen to be about half in tables I. and III. In table II. the diameter of base has dwindled to less than one third of the original, or to less than one fourth of the height of the vessels, giving the latter a top-heavy and unstable character.

For the approximate dates of vessels belonging to the series of grave groups in the Provincial Museum in Trier, acknowledgment is due to Dr. E. Krüger, director of that museum.

Mr. Arthur G. Wright, Curator of the Corporation Museum, Colchester, has kindly looked over the proofs.

TABLE OF STANDARD PROPORTIONS.—I.

BEAKERS and GOBLETS decorated *en barbotine*, including CASTOR WARE. Forms 52 and 55.

Date.	*Provenance.*	*References.*	*Dsscription.*	HEIGHT 100.		
				Rim.	*Bulge.*	*Base.*
I. Cent.	Trier Prov. Mus.	Curle, Newstead p. 255, Fig. 1	Leaves on stalks	86	120	50
,,	,, ,,	,, ,, 2	Leaves on stalks and Animals	81	108	46
40—60	Hofheim	Nassau. Annal. (1904), VI., 15	Scales	82	107	40
II. Cent.	Kees, near Nymwegen	Bonn. Jahrb., 116 p. 44, Fig. 1	Gladiators; Greenglazed	81	98	38
140—180	Newstead	XLVIII., type 45 L. 7	Animals	78	88	37
Probably II. Century	Colchester Mus.	Taylor Coll.	Gladiators	70	93	37
	York Mus.	Cat. X., 5	Animals	81	100	36
	York Mus.	Cat. X., 6	Animals	80	100	34
	York Mus.	Cat. X., 3	Animals	64	87	34
	Colchester	Walters, Cat., XVI. 1	Chariot Race	76	93	32
II.-III. Cent. (?)	Corbridge	Arch. Ael. 3 Ser. V., Fig. 45	Animals	56	78	30
	,,	,, ,,	Animals	54	77	29
Coins from Severus to Gratian about A.D. 383	Combe Down, near Bath	Scarth, Bath, p. 117, XLVIII.	Animals	64	86	31
	,,	,, XLIX.	Fantastic Animals, tubular ft.	42	68	30
	York Mus.	Cat. X., 1	Animals	61	83	28
	York Mus.	,, 2	Fantastic Animals	57	77	27

Table of Standard Proportions.—II.

Folded Beakers, including New Forest Ware.

Form 55. Koenen, XII., 26.

Date.	*Provenance.*	*References.*	*Description.*	HEIGHT 100.		
				Rim.	*Bulge.*	*Base.*
B.C. A.D. 11—9	Haltern	Westfalen. Mitteil. V., XI., 1, type 44	Glazed and Indented	100	126	70
A.D. 69—96	Andernach Graves	Koenen, XII. 26	Folded and rough cast	64	76	35
,,	Newstead, Curle	XLIX,, B, G, XLVI, type 31	Folded and rough cast	76	87	33
,,	Wilderspool	Warrington Litt. & Phil. Soc. 1894-5, p. 28	Mica-dust'd	73	89	40
50—117	Praunheim	Hedd. Mitteil. IV., XII., 39	Coin of Vespasian A.D. 69–79	59	74	33
100—150	Arnsburg	ORL XVII. VII., 26	—	67	89	41
,,	,,	,, 31	—	64	93	33
140—200	Stockstadt	ORL XXXIII. X., B, 15	—	55	78	30
,,	,,	,, 21	—	62	76	36
133—200	Heddernheim, Kilns	Hedd. Mitteil IV. XXI., 21	Varnished	65	91	39
,,	,, ,,	p. 126, Fig. 12	Varnished	50	74	28
Late Empire	Andernach Graves	Koenen XVI., 9	—	49	72	22
	Castor, Normangate	Vict. Hist. Northants I., 212, Fig. 33	Indented and Scales	71	84	33
	Colchester Mus.	Joslin Coll., Grave group 46, 267	New Forest	38	57	28
	Rotherley (Excav. Cranborne Chase)	Pitt-Rivers, II., CVIII., 1	New Forest	32	52	26
	Theale	Reading Mus.	New Forest	44	51	26
	Colchester Mus.	Report (1905) 856	Coated red	40	59	22

TABLE OF STANDARD PROPORTIONS.—III.

BULBOUS GOBLETS, including RHENISH WARE.

Form, Koenen XVI., 10—13.

Date.	*Provenance.*	*References.*	*Description.*	HEIGHT 100.		
				Rim.	*Bulge.*	*Base.*
B.C. A.D. 30 — 14	Andernach Graves	Koenen, IX., 18	Raised Ornament	72	108	47
A.D. 140—190	,,	,, XVI., 10	Bulbous	62	108	41
About 200	Kölner Gräber	Bonn. Jahrb., 114-5 XXIV., 40*e*	Bulbous	55	106	44
200—250	,,	,, 44*c*	Bulbous	61	103	36
,,	,,	,, ,, *b*	Bulbous	64	95	34
,,	Colchester Mus.	Joslin Coll., 1231	Rhenish VINCOTE	54	98	36
,,	York Mus. Cat.	Plate V*a*	DAMI	42	56	28
,,	,, ,,	,, *b*	VIVATIS	47	81	33
,,	,, ,,	,, *c*	DAMI	46	85	31
,,	Kölner Gräber	XXV., 56*b*		36	65	24
,,	Trier Prov. Mus.	Dr. Krüger		34	63	25
About 267—273	Ullington	Maidstone Mus. Report, 1907		47	71	28
300—350	Trier Prov. Mus.	08·223*a*	VIV..	39	63	25
,,	,, ,,	08·223*b*	AL...	37	61	24
,,	,, ,,	04·930*d*		35	61	25
Constantine 306—337	Kölner Gräber	Bonn. Jahrb., 114-5 XXV., 62*g*	BIBAMVS	37	60	22
IV. Cent.	Colchester Mus.	·04 Gen. Coll.	NEW FOREST Painted	43	75	25
About 423	Reading Mus.			33	67	23
V. Cent.	Colchester	Joslin Coll. grave group 75, No. 428		38	73	22

DESCRIPTION OF THE PLATES.

I. VESSELS WITH COLOURED COATING.

c. Varnished and Slip-coated wares:—(including Castor and and New Forest Wares).

Plate X.

I. BARBOTINED.

BEAKERS, forms 52 and 55 nearly, coated with variously coloured dull engobe or slip, most frequently dark slate coloured. Castor fabric.

3, 5, 6. 'HUNT-CUPS' OR BEAKERS.

Sharp-edged, grooved lip. Round the body, a frieze of reliefs,—hare or deer chased by hounds, bordered by dots or short strokes.

10, 12. BEAKERS.

Sharp-edged, grooved lip, Round the body, a scroll pattern bordered by dots in relief or slight grooves.

According to Kœnen, p. 86, plate XII., 25 this type first appears in the Flavian period, *i.e.*, before A.D. 96. It is found fully developed in the Antonine period, A.D. 140-180, at Newstead. Curle, *Newstead*, p. 254, plate XLVIII., type 45.

A green glazed vessel of similar type, with gladiators, found near Nymwegen, is assigned to II. Century. *Bonn*, *Jahrb.*, 116, p. 44, fig. 1.

Two examples found at Corbridge "may belong to the II. or even the III. century." Haverfield *Arch. Ael.* 2nd Series, V. (1909), p. 115, fig. 45.

Walters, *Cat.* I., M 2479—2517, plate XVI.

1, 2. BEAKERS.

Plain lip and ringed foot. A slight girth-groove half-an-inch to an inch below lip. Round the body, a belt of reliefs—animals of fantastic form, (1) dog and hare, (2) deer with head turned back and neck unnaturally extended—bordered by dots.

7, 9, 13. BEAKERS.

Plain lip and ringed foot. A slight girth-groove about half-an-inch below lip. Round the body, a scroll pattern bordered by dots in relief.

4. BEAKER.

Plain lip. Round the body, two rows of leaves with curved stalks and pointed ends bordered by elongated drops in relief.

8. Goblet, on upright tubular foot.

Beaded lip. Round the body, scroll pattern in relief bordered by roulette-notched grooves.

11. Goblet, on upright tubular foot, coated with Greek glaze of metallic lustre. Rhenish fabric.

Beaded lip. Round the body, a scroll pattern with heart-shaped leaves ending in sharp points in relief, bordered by roulette notched grooves.

Nos. 8 and 11 are a later development, of which an example was found at Bath, in association with a hoard of coins from Severus to Gratian, and therefore not earlier than the end of the IV. Century.

Scarth, *Roman Remains at Bath*, p. 117, plate XLIX.; *Journal Brit. Arch. Assoc.*, 31 March, 1863.

Another example found at Corbridge is recorded by Haverfield, *Arch. Ael.* 2nd Series, V. (1909), fig. 44.

Plate XI.

3. FLUTED, FOLDED OR INDENTED.

Fluting, foldings, and indentations on the sides of round bodied beakers are evidently intended to provide a finger hold, instead of handles; and the sides of the same vessels are frequently 'rough-cast,' or coated with particles of sand, or clay fastened on by means of the glaze, for a similar purpose.

Though rare in the early Roman period they have been met with on stunted, wide-mouthed round-bodied beakers, both green-glazed and varnished, in the great camp at Haltern in Westphalia, dating from about B.C. 11 to A.D. 9. Loeschcke, *Haltern* V., p. 192, type 24; p. 222, type 44, plate XXI., 4.

The irregular character of the indentations distinguishes these vessels from those of later date, on which the foldings are vertical and at regular intervals.

Among the earliest recorded examples in this country are those belonging to the Flavian period, not later than about A.D. 96, found at Newstead. These are likewise rough cast.

Curle, *Newstead*, p. 248, plate XLVI., type 31, and XLIX. (B), fig 6.

The thick-set, deeply indented beakers, with thin sides, well saturated with colour-coating or varnish, and also usually 'rough-cast,' are stated to have first appeared in the Rhine district before the end of the Flavian period, by Kœnen, p. 86, plate XVI., 26.

In a developed form folded beakers were made in large numbers in the Roman potteries at Heddernheim and Heldenbergen during the whole period of their activity from about A.D. 117 to A.D. 200.

Welcker, *Heddern. Mitteil.*, IV., p. 136, figs. 12, 13. Wolff, ORL XIII., No. 25, *Heldenbergen*, p. 11, plate III.

They are the commonest shape produced in the New Forest potteries in Hampshire, which are shown to have been at work down to the beginning of the V. Century, by a hoard of coins found near the site, which included examples of Magnus Maximus and Arcadius, extending to A.D. 408 or shortly afterwards.

Each of the vessels illustrated represents a single example of an important series.

1. SMALL BULBOUS GOBLET.

Weakly moulded lip and ringed foot. Light brown paste with dark brown varnish of slight metallic lustre.

Round the bulge, about 16 vertical indentations, which are bordered above and crossed below the middle by roulette-notched grooves. On the inside strongly marked rings from careless throwing are indicated.

The form is that of the Rhenish 'motto-goblets' of about A.D. 200—250.

2. UPRIGHT FLUTED BEAKER. One of a series in Case B, Castor fabric.

Plain lip and foot. Light brown paste with dull brown to glossy reddish-brown slip, mottled with light pinkish-red near the foot.

Round the body, six oval indentations bordered by slight girth-grooves; moulded and applied overlapping scales on the shoulder and projecting ridges.

Vessels of similar type, preserved in the Museum of the Natural History Society at Peterborough, are from the site of the potteries at Castor, about four miles west of the city. Others are illustrated by Haverfield, *Vic. Hist. Northants.*, I., opposite p. 212, fig. 33; Artis, *Durobrivæ*, plate 53, fig. 1; Walters, *Cat.* M 2734, fig. 279, among II. and III. Century fabrics.

3. FOLDED GOBLET, on high tubular foot.

Externally coated with dark-brown metallic lustre; inside dull red.

The body folded into nearly square section by deep indentations in the middle of each of the four sides; the mouth and foot circular. On the shoulder below the lip and near the foot, slight grooves; on the body at nearly equal intervals of an inch, three roulette-notched girth-grooves, all evidently made before the folding.

A goblet of similar four-sided form is described as New Forest ware of late date, by Pitt-Rivers, *Excav. in Cranborne Chase*, Rotherley, II., plate CVIII., No. 1.

Another example closely resembling the York one, but coated with black lustre, is in the Colchester Museum, Gen. Coll., No. 141.

Folded, fluted and indented drinking vessels were made in large numbers in both the Castor (Durobrivæ), and New Forest potteries.

4. LARGE FLUTED BEAKER, with cylindrical neck rising from a bent-in shoulder.

Plain lip; ringed foot. Matt greyish-black slip, shading off into red near the base. Round the body long oval indentations.

The proportions (40 : 65 : 29), indicate a late III. Century date.

This vessel is one example of a series that can hardly be regarded as drinking vessels, as it stands $9\frac{1}{4}$ inches high.

5. ROULETTE-NOTCHED (engine-turned or hatched).

Roulette notches in single rows, or covering zones and surfaces are met with on vessels of every variety of shape and size throughout the Roman period. That they are produced mechanically with a little toothed roller or roulette is evidenced by their being of equal size and at equal distances. A roulette found on the site of the potteries at Heddernheim in 1904-5, is described by Welcker (*Hedd. Mitteil.*, IV., p. 111, fig. 3, No. 1), as a small solid bronze wheel or cylinder 19 mm. ($\frac{3}{4}$ inch) in diameter, and 9 mm. ($\frac{3}{8}$ inch) wide, pierced in the centre with a 4 mm. ($\frac{5}{32}$ inch) hole for an axle, and toothed or grooved round the edge in a parallel direction to its axis. Near to it were vessels marked with its impressions.

This technique is of Italian origin, and is wanting on vessels of the preceding Late Celtic or La Tène period. One of the earliest examples in this country is a sigillata ware cup in the Reading Museum from Silchester, with doubly curved sides, coated with horn-coloured glaze, the upper zone of which has been roulette-hatched before glazing. This cup, which is of Arretine fabric and of the Augustan period, is the prototype of the similarly shaped cup, form 27, of La Graufesenque and Lezoux fabric, which became so widely distributed during the first and early portion of the II. Century.

Loeschcke, *Haltern* V., p. 150, type 11, Abb. 4, 11—13.

The hatched patterns, carefully made with a roulette, covering the rim above the moulded ornaments on the carinated sigillata bowl, form 29, were also in imitation of an Arretine prototype.

5. GLOBULAR BOTTLE, with short neck, circular, two-ribbed handle, and cylindrical five ringed mouth-piece.

Brownish-white paste with reddish brown slip.

Round the body, two one-inch wide bands of roulette hatching and two slight girth-grooves.

A vessel of similar shape is recorded by Kœnen, *Bonn. Jahrb.*, 86, Grabfunde in Andernach, grave No. 21, 8, plate VII., found with coin of Caligula, A.D. 37—41.

Colchester Mus., Joslin Coll., grave group 49, No. 283.

6. SMALL BEAKER, form 55, with markedly concave lower profile. Black varnish.

Plain lip; prominently ringed foot.

Round the body, a girth groove 1 inch below lip; beneath which, three belts of roulette-impressed lines bordered by birth-grooves, about $\frac{1}{4}$ inch apart.

The contracted foot and slender proportions (49 : 67 : 22), point to a late IV. Century date.

7. SMALL BULBOUS GOBLET, with long tubular neck, and high curved foot; an off-set on shoulder.

Reddish-brown glossy slip.

A band of roulette-hatching, $1\frac{5}{8}$ inch wide, covering the bulb, bordered below by a double girth-groove.

The slender proportions (39 : 57 : 25), point to a late III.—IV. Century date.

8. WIDE-MOUTH OLLA.

Out-curved lip; sub-angular bulge; base conically contracted from near the middle to a narrow ringed foot. Nearly white paste, with glossy black varnish.

Round the body, at intervals, three bands of roulette-hatching, the two upper ones bordered by grooves.

Very common in Antonine grave-fields, A.D. 140—190, Kœnen, p. 100, XVI., 6.

Hagen, *Bonn Jahrb.*, 114—115, Kölner Graber, p. 404, plate XXIII., grave 32, c, A.D. 188—220; p. 420, plate XXV., grave 56, a, with coins of Postumus, A.D. 258—267.

9. **Cover-lid** for a wide bowl, diam. $8\frac{1}{16}$ inches. Cylindrical sides $\frac{7}{8}$in. high; conical top rising to a ringed holder. Castor fabric.

Pale paste coated with black varnish.

The sides and half the top surface covered with roulette-hatching bordered by double grooves at the angle and inside edge.

The shape of the bowl with lid is shown above in outline, taken from Artis, *Durobrivæ*, plate 49, fig. 4.

Walters, *Cat.*, M 2732, fig. 278.

Peterborough Museum, Huntley Collection, similar example from Orton, near Castor (Durobrivæ).

Guildhall Mus. Cat., XLVI., 12.

Brit. Arch. Assoc., vol. II., from Billericay.

Colchester Mus., 998 and fragments.

Plates XIIa and b.

8. Painted or parti-coloured.

The purely decorative use of painting with colours was unknown in the Augustan period, and is seldom employed until the Rhenish 'motto-goblets,' with lettering and other ornaments in white and yellow slip came into use in the middle of the III. Century. Not until the Constantine period, or beginning of the IV. Century did painted ornamentation come in common use. New Forest painted wares are represented at York only by fragments. Castor-ware specimens are naturally more numerous, the two places being joined by a direct highway and by the two nearest navigable rivers.

1. **Globular Vase** (partly restored from fragments), on a pedestal foot with out-bent thickened lip, form 54.

Dark red with bright red glaze resembling terra sigillata.

Round the body, pattern painted in slender lines of white slip, before glazing, consisting of lozenges with vertical diagonals and dividing lines, and, in the inter spaces, a row of discs encircled by small dots, and of berries in triangular symmetry, 3 : 2 : 1.

Patterns composed of discs or berries with raised centres painted in white slip is a kind of ornament which was prevalent in the Constantine period,—first half of IV. Century. Kœnen, p. 110, XVIII., 1—13.

A Castor ware goblet painted with a similar pattern, but of a different shape, is illustrated in the Guildhall Mus. Cat. XII., 14.

2. Beaker, form 55, with angular lip and plain foot.

Matt dark brown slip.

Round the body, a row of oblique parallel bars, $\frac{3}{32}$ inch thick, $\frac{5}{8}$ inch apart, in white slip.

The markedly concave profile of the lower portion is a late feature.

Castor fabric. III.—IV. Century, Kœnen, p. 100—101, XVI., 5.

3. Goblet, on high tubular stand with projecting lip and foot ring.

Dull dark brown varnish.

Round the body, a row of rings, $\frac{5}{8}$ inch in diameter, painted in white, bordered by deep girth-grooves.

The form of foot, slender proportions, and ornamentation, indicate a IV. Century date.

4. Goblet, on high tubular stand, with slightly moulded lip. (Somewhat distorted in shape).

Brown paste with glossy greenish black varnish.

Round the middle, a series of oblique bars in sets of three, alternating with rings, $\frac{5}{8}$ inch in diameter, dotted in the centre, painted in white. Above and below, roulette-notched grooves, Near the foot a slight girth-groove.

Shape, slender proportions, and ornaments suggest a late date, IV. Century.

5. Globular, Narrow-necked Vase, with strongly out-curved lip and ringed foot. At the joining of neck and shoulder a false cordon or ring pressed out from the inside.

Round the body, three painted belts, $\frac{1}{4}$ inch wide, in dull brown-red pigment.

6. Pear-shaped, Narrow-necked Vase, with strongly out-curved lip and small foot-ring.

Light brown paste.

Similarly painted with four belts, about $\frac{1}{2}$ inch wide, in dull reddish brown pigment.

The pigment employed is probably hæmatite, or ground ironstone (‘ mine ’).

7. Tall Wide-mouthed long-necked Jug, with disproportionately small handle.

Hard light brown paste, unglazed.

Round the shoulder five or six ill-defined belts of red pigment.

This kind of ornament was in common use at the end of the IV. Century. Kœnen, p. 108, XVII., 22.

8. Body Fragment of Globular Vessel, New Forest fabric.

Red brown paste, coated with glossy brown-black varnish.

Round the body, a double-lattice pattern painted in white slip, bordered below by a roulette notched groove.

New Forest Ware.

Though only represented by a single fragment of painted ware, the New Forest wares are too important and interesting to be omitted. They include the three following sorts—

1. Hard stone-ware, containing a large proportion of ferro-silicate (iron-slag), with dark maroon varnish and painted patterns burnt in and clouded by the high temperature of the kiln.
2. Soft pale paste, usually colour-coated red, and painted with patterns in white slip, the colours retaining their brightness owing to the lower kiln temperature.
3. Black earthen-ware vessels with fluted sides of coarser texture.

Pitt-Rivers, *Excavations in Cranborne Chase*, IV., p. 14; II., p. 142, plate CVIII., No. 1.

As above stated, the potteries are shown by a hoard of coins to have been at work down to the beginning of the V. Century.

Plates XIIIa, b, c.

FACE VASES.

1. Amphora, in shape suggestive of the Mycenean 'bügelkanne' or false-necked vase, broken and wired together, but complete; the mouth still sealed with clay and the contents undetermined, supposed to be burnt bones; the handles roughly semi-circular.

Dark reddish paste with lighter red slip coating.

Ornaments affixed to the upper cylindrical portion of the neck on either side: (1) a human face with somewhat tragical expression, (2) a vertical strip of clay (false or rudimentary handle) 2 inches long by $\frac{5}{8}$ inch wide.

On the shoulder, below the neck, a row of ∽-shaped scrolls; on the upper portion of the body, running and winding scrolls bordered by engrailments, all in white paint.

Castor fabric. Found at Carr Naze, Filey, Yorks., in 1857.

A smaller vessel, without face-mask, but of somewhat similar shape and painted ornamentation, is illustrated and described by Jewitt, *Ceramic Art in Great Britain*, p. 38, fig. 34.

Colchester Mus., Collection of Castor Ware, No. 732.

A neck-fragment of a similar vase from the site of the potteries at Castor is in the writer's collection.

2. Mouth-piece and part of neck of a Flask, on one side ornamented with a female face, and on the other with a flat double band of square section, like a rudimentary handle.

Whitish-grey paste.

Round the upper portion of the face, a raised band notched across to represent a fillet. Across the forehead, a diadem shaped band. The hair, eyebrows, head-dress, &c., are represented by painted bands of reddish-brown pigment.

Such vessels are included among IV. Century wares, by Kœnen, p. 108, XVII., 20.

Walters, *Cat.* liii., M 2757---2760, III Century ?

Wallis-Budge, Cat. of Chesters Mus., p. 68 and 391, No. 19, table-case A.

Colchester Mus., Joslin Collection, grave groups 15, No. 83 ; 12, No. 58 ; 11, No. 51 ; 36, No. 213. This museum also contains the mouth-piece of a similar flask of larger size, decorated with a female face of much finer modelling, probably a work of Hellenic art, such as forms the prototype of the later Roman examples. Gen. Coll. 702-04.

They are stated to be a type of pottery of the III.—IV. Centuries, by Déchelette, II., p. 324, plate VIII., 3.

3. Vase, in the form of a complete human head (female). The opening is on the top of the head and encircled with a plain rim. A flat base is formed by the lower portion of the neck.

Soft, light, reddish-brown plain clay.

Nose prominent ; hair indicated as tightly drawn back from the face and knotted in the nape of the neck, and the separate locks by shallow grooves.

Déchelette, II., p. 323 (3), plate X., 2, 3.

Tudot, *Figurines gauloises*, p. 5, fig. VIII.

4. Vase, in the form of a complete female head.

Wide open at the top and finished unevenly without a rim. Broad and flat below, the neck being cut off short below the chin.

Face coated with dull red slip.

Locks of hair represented by grooved spirals and dark brown-red pigment. Eyebrows, eyelids, and lips also, rudely moulded and painted with dark colour.

Déchelette, II., p. 322.

5. FRAGMENT OF A LARGE WIDE-MOUTHED OLLA, with a rude representation of human face (nearly complete) upon the shoulder.

The outside edge of the rim is ornamented with two square cut mouldings notched across and carefully finished. At the joining of the neck and shoulder are two round mouldings or cordons. Of two small three-ribbed handles of square section one only is preserved. The eyes and lips are represented by bosses of clay slit across with a knife. The ear is also an applied strip of clay. The eye-brows are similarly formed, but suggest goat-horns,—those of the god Pan. The nose and chin are simply out-pressed from the inside.

The body is of hard grey clay, without glaze, but well polished.

9. VESSELS ORNAMENTED WITH FRILLED CORDONS. 'INCENSE BOWLS.'

These frequently form part of the furniture of cremation graves both in Britain and on the Continent. Sets of four are sometimes found in one grave, and they were doubtless regarded as of some use or significance for the future welfare of the departed.

Riese, *Hedd. Mitteil.*, IV., p. 28, plate V., 10, 12. A.D. 90—150; Welcker, Ibid., p. 140, plate XXI., 15, 17. A.D. 133—200.

Colchester Mus. contains numerous examples.

Guildhall Mus. Cat., plate XLI., 7.

Walters, *Cat.*, liii., M 2750—2756, 2860.

Kœnen, pp. 98—99, XV., 25—29, mentions their frequent occurrence in the time of the Antonines, A.D. 140—190. Their prototype is supposed to have been found at Priene. Wiegand and Schrader, *Priene*, p. 279, fig. 287.

Examples, already with the wavy band round the lip, which was retained for centuries, and precludes their use for drinking purposes, are recorded at Haltern, which dates from B.C. 11 to A.D. 9. Lœschcke, *Haltern* V., p. 213, Abb. 19, type 37.

Among the earliest of known date found in Britain is the fragment belonging to the Flavian period found at Newstead (op. cit., p. 52), A.D. 69—96.

Their intended purpose is still in dispute, some authorities being of opinion that they were used, as their name implies, for burning incense at the funeral pyre during cremation; others that they were for containing offerings of food or wine, or for pouring libations. Riese (op. cit., p. 28), points out their resemblance to the medieval 'grease pots,' and suggests that they may have been lamps or candle-sticks (a sort of 'night light' possibly), since they have been found with a nozzle for a wick, and also with a socket for a candle.

6. Chalice-shaped Bowl or Tazza, of rude workmanship.

Yellowish coarse clay coated with white slip.

Plain curved stem joining a slightly moulded expanded foot. Round the rims of a conical bowl, cordons notched at intervals with a blunt edge.

7. Chalice-shaped Bowl or Tazza, of rude workmanship.

Yellowish coarse clay coated with white slip.

Slightly moulded stem on a high cylindrical plain foot. Round the middle portion of a conical bowl, two thin bands of "frilling" with edges turned upwards.

Unornamented Vessels. Though too numerous and variously shaped to be separately described, mention should be made of the little vessels known as 'unguent pots,' which are the commonest and best preserved objects among Roman grave furniture. The York examples are most frequently miniature beakers (form 55), of pale paste, coated with chocolate-brown or pinkish-red slip.

They appear to have in part superseded the well-known thin tubular glass *unguentaria* (or 'lachrymatories'), which served a similar purpose of creating sweet odours when thrown upon the funeral pyre, or into the grave along with the ashes, during the earlier period, down to about the end of the I. Century.

Riese records the occurrence of innumerable little vessels, the so-called '*salben töpfchen*,' in almost every grave, usually of grey clay coated with blackish or grey slip, in the Roman grave-field at Praunheim, near Heddernheim, which he dates from about A.D. 90 to 150. *Hedd. Mitteil.*, IV., p. 28, plate I., figs. 35, 36, 37, 50, &c.

Kœnen, XII., 24; XVI., 5, 7.

II. FUMED WARES (INCLUDING BELGIC, UPCHURCH, AND OTHER SMOKE-TINTED OR SMOTHER-KILN WARES).

It is here primarily necessary to furnish a summary of the facts which justify the inclusion of Belgic, Upchurch and other smoke-tinted or smother-kiln wares in one and the same category of 'fumed' wares. The chemistry of the process of fuming has already been explained.

The term Belgic has been applied to terra nigra (deep black glossy coated), orange red and grey wares imitating Arretine and Southern Gaulish sigillata shapes of vessels in native Celtic or La Tène technique. They were first produced by South Gaulish potters, who extended the manufacture into Gallia Belgica when that province came under Roman influence, particularly in the neighbourhood of Trier, from the time of Augustus to the Flavian period, or for not more than about two generations.

The authorities are agreed that the Belgic wares were coloured in the firing process, solely according to the sharpness of the baking, grey, black or light red, the red variety having been found by Lehner in the same patterns, in the same potters' kilns at Trier, as the black.

The black colour is stated by Ritterling and Dragendorff* to be produced, like that of the Italian *bucchero* vessels, by steaming in smoke fumes and rubbing in of carbon particles of soot, and not by a laid on colour. The light red they consider to be only more sharply baked than the grey and black ; and its glossy surface to be due to a fine burnishing, and not to a coating or glaze. The grey vases found along with them are included with the terra nigra, since they differ only in showing the natural colour of the clay, whilst the others are artificially blackened, or partly black and partly grey.

More recently the name of Belgic has been used by Loeschcke, not only for imitations of sigillata produced in Late Celtic technique, but also for a coarser description, the autochthonous Belgic types, such as cooking pots, store vessels, &c., which came more into prominence with the abandonment of sigillata imitation in those countries still retaining the Late Celtic culture, Gaul,

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* *Bonn. Jahrb.*, XCVI., p. 96 ; Ritterling, *Nassauer Annal.*, XXXIV, (1904), p. 76 ff.

Belgica, and the Danubian lands, where they lasted for centuries.[*] These are, therefore, the types found so abundantly in the Romano-Belgic cemeteries recently excavated in Belgium,[†] and forming the accumulations in the turf bogs of Flanders and in the Upchurch marshes referred to.

The characteristic colours of Upchurch ware are grey, slate-colour, brown and black, and, as previously stated, most of the examples are equally common in France, Belgium and Germany. It only remains to be pointed out that, according to C. R. Smith[‡], the processes adopted to give bluish-black and slate coloured pottery its characteristic colour on the Nen and on the Medway, must have been identical. His words are, "My friend, the late Mr. Artis, who carefully examined specimens of the dark Upchurch pottery, decided that the colour was produced by suffocating the condensed smoke of vegetable substances in a description of kiln well-known to him, termed smother-kilns," which were among those excavated by him on the banks of the river Nen in Northamptonshire.[§]

As already explained, soot and fine carbon particles have been dismissed by modern chemists from the category of ancient colouring ingredients, and replaced by black iron oxide and ferro-silicate,[||] the latter being a stable and refractory substance, familiar in the forms of iron slag and obsidian, quite capable of being produced by steaming in smoke fumes and of bestowing on Late Celtic and Romano-British fumed wares, Belgic terra nigra, early Italian *bucchero nero*, as well as on Greek glazed black vases and pre-historic Egyptian earthenware, the black lustre which has resisted 15 to 50 centuries of decay.

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[*] Loeschcke, *Westfalener Mitteil*, V. p. 264.

[†] *Ann. de la Soc. Arch. de Namur*, VII., and *Id. de Bruxelles*, V.

[‡] Collectanea Antiqua, VI., p. 179, ff.

[§] The MS. of the account given by Mr. Artis of this kind of ware is in the writer's possession.

[||] Whether found naturally in the clay, or added in the form of rouge, hæmatite, ground iron, or 'bull-dog.'

Plates XIVa and b.

(a) FUMED WARES (INCLUDING UPCHURCH, &c.)

1. EWER, with round body on a plain cylindrical base 1½ inch high; strong handle rising vertically from the rim, which is pinched in vertically to form a spout. Castor fabric.

Dirty grey pasty clay, smoke-tinted to a darker surface; very heavy in weight.

Round the shoulder, rays or radiating grooves, 1¼ inch in length, extending from the joining of the neck, where there is a cordon and roulette notched groove; just below the lip, a slight groove.

Another example is coated red.

A similar ewer, of buff paste, black coated, in the Peterborough Museum, is from Castor (*Durobrivæ*).

2. NARROW-NECKED FLASK OR BOTTLE.

Dark grey paste, thickly black coated; very heavy in weight.

Round the bulge, narrow roulette notched rows in three groups of 2, 2, and and 4 respectively.

3. STUDDED BEAKER, globular bodied, with short upright neck and ringed lip and foot.

Thin fumed grey paste.

Round the upper portion of the bulge, rows of clay studs in oblong groups. At the joining of the neck and body a slight cordon and groove; the under base carefully turned and hollowed.

Proportions, 73 : 95 : 39.

Cf. Koenen, p. 85, XII., 16.
Walters, *Cat.* ii., M 2641—2657 Upchurch ware.
Guildhall Mus. Cat., XLIII., 2, 3, 4, 6.
Lehner, *Novæsium*, XVII., 22 (A.D. 25—105).

4, 5. RIDGED OLLAE, with small obliquely outset lip, ringed foot, and carefully turned slightly concave under base.

Fine hard fumed grey clay with darker coating.

4. Round the body, a band, 3⅜ inch wide, of raised rustic work *en barbotine* consisting of rough edged up and down ridges joined in the middle by a horizontal ridge; at the joining of neck and body, a ring or cordon.

Proportions, 83 : 92 : 43.

5. Round the body a band of rough edged rustic work ridges, like diminutive mountain peaks, at irregular intervals.

Proportions, 80 : 110 : 42.

The origin of ridged ornament in the studs and ribs of the Late Celtic and Belgic ollæ is illustrated by these two examples (see

Table of Proportions, No. IV.) Both kinds of ornament (studded and ridged), have been found together on similar ware in a deep pit at Wilderspool during excavations in 1910.

6. Globular-bodied Beaker, form 68 nearly.

Grey fumed ware of light weight.

At the junction of neck and body, a ring or cordon; high out-curved foot and carefully grooved and hollowed under base.

Proportions, 53 : 79 : 35.

Two other examples, (a) similar; but with double girth-grooves at joining of neck and body, (b) similar; but with two bands of roulette hatching, ¾ inch wide, on shoulder.

Proportions, (a), 53 : 77 : 34; (b), 58 : 80 : 29.

7. Large Beaker or Olla, of somewhat similar type, but with much broader base.

Light grey paste with darker surface; very heavy in weight.

Round the lower part of the body, seven rows of roulette indented impressions ½ inch in length; at the joining of neck and body, a ring or narrow cordon bordered by grooves; the under base carefully grooved and hollowed.

Proportions, 60 : 85 : 43.

8. Wide-mouthed Olla, with upright neck and ringed lip.

Coarse dirty grey unglazed paste, slightly micaceous; heavy in weight.

Round the middle of the bulge, two intersecting wavy scored lines, and above and below single rows of oval indentations or stabbings; round the neck and shoulder slight girth-grooves.

Proportions, 74 : 93 : 39.

Found at Boston, Yorks., in 1848, containing 172 silver coins.[*]

9. Globular-bodied Olla, on high curved foot, with straight, narrow-lipped, obliquely out-set rim.

Light drab paste with rather darker surface.

Round the shoulder, a raised band of roulette hatching bordered by mouldings.

Proportions, 47 : 89 : 28.

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[*] The following note on the coins contained in this vessel has been kindly furnished by Mr. Oxley Grabham, M.A., M.B.O.T., the curator and the well-known naturalist:—

"The vessel you mention was found at Boston on the Wharfe, about three miles from Tadcaster (the ancient Calcaria), in 1848. It contained 172 silver denarii, of which many belonged to the Republican or family series, and were much worn. The remainder were of the emperors down to Hadrian, during whose reign the hoard was probably concealed, those of Nero, Trajan and Hadrian being in excellent preservation."

The narrow base indicates a late II.—III. Century date. The form is common in the *castella* of the German *limes* ; *e.g.*

Orl, XXVIII., No. 59, Cannstadt, plate VII., 21.

10. Wide-mouthed Bowl, with carinated bulge.

Hard grey paste, like stone ware.

Round the bulge near the angle, four slight girth-grooves ; and half an inch below the lip, one girth-groove.

Cf. Colchester Mus., Gen. Coll., No. 516 and 421.

Similar bowls from Pocklington and South Ferriby are in Hull Museum.

11. Bowl or Porringer, with straight sides obliquely out-set, and a thick angular flange just below the small upright lip.

Coarse brownish, nearly black fumed ware ; very heavy in weight.

Plate XV.

(b) Belgic Red and Grey Vessels in imitation of Sigillata.

12. Neck and Handle of Pitcher,—tall, slender bodied and elegantly shaped.

Fine hard brown-red paste, with pinkish-red slip ; the surface polished by an up and down motion of the burnisher.

Flat band handle bent at an acute angle.

Cf. Koenen, p. 71, IX., 16, Early Empire, and p. 82, XII., 4.

13. Ewer, oval bodied, with angularly bent, moulded handle extending at right angles from the lip ; tubular spout turned slightly upwards ; and ring moulded food.

Light pinkish red coated, to imitate sigillata.

A similar example in the Colchester Museum, Joslin Coll., No. 618 is of red micaceous paste. The spout is evidently imitated from a bronze ewer in the same museum, Gen. Collection, No. 108.

14. Elegant, nearly upright-sided Bowl, with bead lip, a slight offset or expansion near the middle, and low foot-ring.

Fine, brown-red paste, polished on the outside, but retaining the ribs of turning on the inside.

The form is that of the silver cups with mask friezes of Alexandrian origin, recorded by Drexel, *Bonn. Jahrb.*, Heft 118, plates VI., 8, VIII., 5, as occurring somewhere in the early Flavian period, A.D. 69—76.

15. Calyx-shaped Cup, with expanded square-edged lip; an expansion below the middle; and low carefully turned foot-ring.

Hard light brown-red paste.

The form resembles that of two cups found in a tile-built grave of about the II. Century at Remagen, recorded in *Bonn. Jahrb.*, 110 (1903), grave No. 41.

16. Shallow round-sided Bowl, with bead lip, and obliquely expanded, moulded foot-ring.

The form lies between those of the sigillata bowls, forms 31 and 37.

Fine hard light brownish-red past, surface polished.

The flat stand-ring is a constant feature of the sigillata-imitating Belgic plates, though examples on which it is wanting occur.

17. Shallow Bowl, with slightly incurved sides.

A bead moulding on the inside lip; an off-set or plain moulding, two concentric rings, and roulette hatched wreath on the inside of the slightly domed base.

Hard, slightly sandy paste, fumed to a nearly black colour; polished inside, but retaining the ribs of turning on the outside.

The roulette-hatched wreath is imitated from the Arretine sigillita plate of the Augustan period, Loeschcke, *Westfalen. Mitteil*, V., p. 262, plate XIV., 72b.

Cf. Koenen, p. 73, IX., 23, 24, Early Empire.

18. Dish or Platter, with slightly incurved sides.

A groove round the inside base, and low-foot ring.

Coarse paste containing quartz grains; bright red, polished outside, brown at the core.

19. Rim Fragment of large Dish or Platter, of similar form, but without foot ring.

White paste, coated with dull light red slip.

TABLE OF STANDARD PROPORTIONS.—IV.

FUMED OLLÆ, with Late Celtic concave profile, ribbed and ridged *en barbotine.*

Date.	*Provenance.*	*Reference.*	*Description.*	HEIGHT 100.		
				Rim.	*Bulge.*	*Base.*
Late Celtic	Haslemere	Proc. Soc. Antiq. Lon. (1906), p. 225, Fig. 4	Studded	Imperfect		
B.C. A.D. 11—9	Haltern	Westfalen. Mitteil. V., Abb. 44, type 86	Belgic, Herring-boned and mica coated	72	92	42
,,	,,	,, ,,	,,	62	82	40
A.D. 40—60	Hofheim	Nassau. Annal., XXXIV., VI., 19	Belgic, Ribbed	73	118	50
69—96	Neiderberg	Orl, XII., plate V., 1	,,	66	115	44
	York Mus.	Cat. plate XIV., 4	Fumed, Ridged, rustic work	83	92	43
	,,	,, XIV*a*	,, (small)	80	110	42
	Carlisle Mus.	228	,,	93	109	43
Early	Silchester, pit 10	Archæologia LXI., p. 482, Fig. 3, No. 8	,,	68	91	41
69—96	Newstead	XLIX. (A), Fig. 3, XLVI., type 29	,,	80	106	40
	Wroxeter	Chester Mus.	,,	73	88	40
83—122	Wiesbaden	Orl, XXXI., plate XIII., 13: plate XIV., 26	Belgic, Ribbed	47	87	34
Early Empire	Andernach	Koenen, p. 72, IX., 11	,,	53	110	34
	Silchester, pit 30	Reading Mus.	Fumed, studded and grooved	67	107	34
	Colchester Mus.	Gen. Coll.	Ridged, rustic work	Fragments		

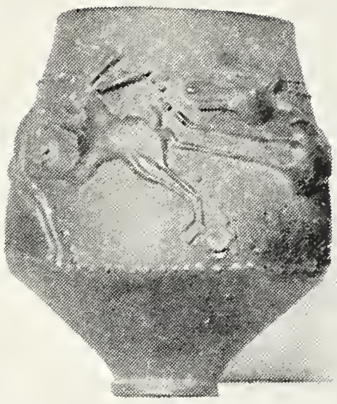
As above indicated, the series is derived from a Late Celtic prototype, and seldom extends later than the end of the I. Century, though a single fragment of a Belgic ribbed olla is recorded at Zugmantel (A.D. 117—136), ORL, XXXII., plate XIX., Fig. 1,

Table of Standard Proportions.—V.

Glazed, Colour-coated and Fumed Beakers and Ollæ, with Roman convex profile, studded and imbricated *en barbotine*.

Date.	*Provenance.*	*Reference.*	*Description.*	HEIGHT 100.		
				Rim.	*Bulge.*	*Base.*
B.C. A.D. 11—9	Haltern	Westfalen. Mitteil., V., XI., type 23	Glazed, Studded	94	115	58
,,	,,	Abb. 11, 43 B	Varnished, Studded	96	112	43
A.D. Early Empire	Andernach Grave	Koenen, p. 85, XII., 15	Imbricated	75	113	52
40—60	Hofheim	Nassau. Annal. XXXIV., VI., 15	,,	83	107	40
	Cologne	Guildhall Mus. Cat. LXIII., 1	,,	75	108	40
	,,	,, 4	Studded	68	105	40
	York Mus.	Cat. plate XIV *b*, 3	,,	73	95	39
	Colchester Mus.	Report 1910, plate II. 1982-10	,,	69	91	34

PLATE X.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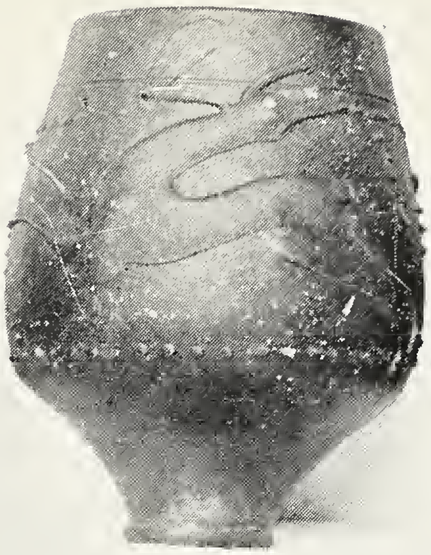
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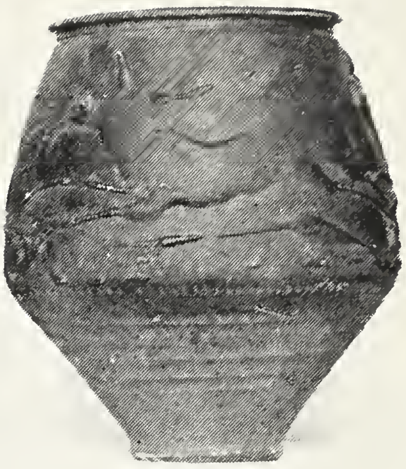
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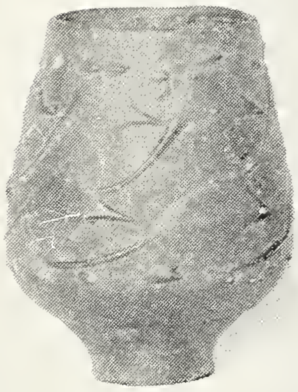
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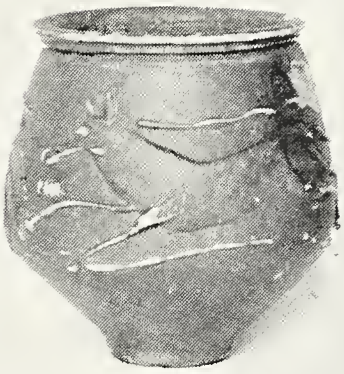
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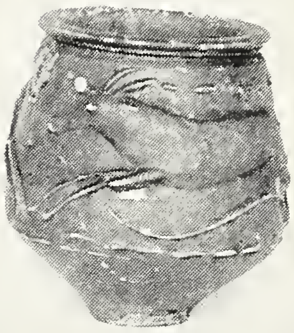
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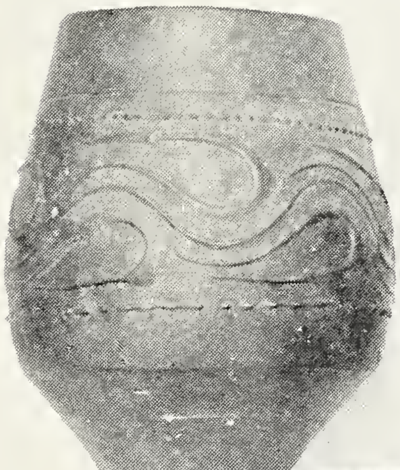

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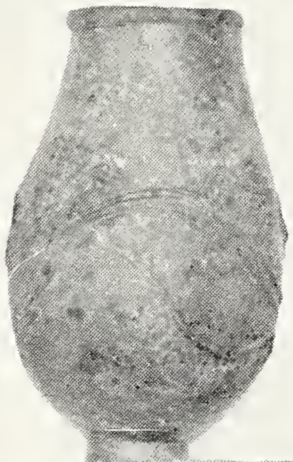

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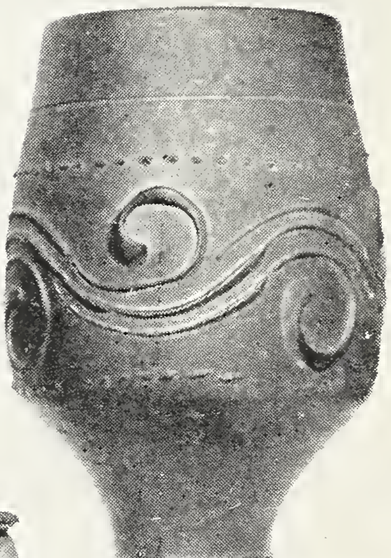

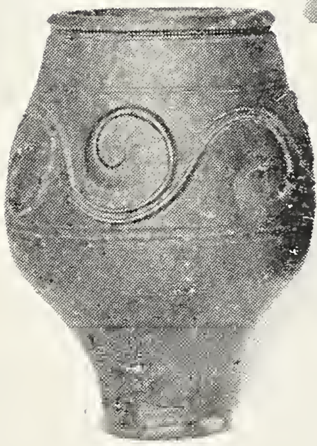
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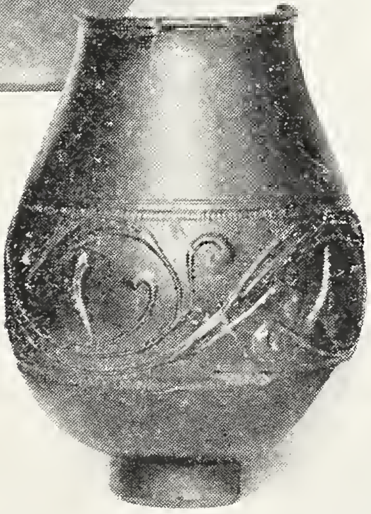
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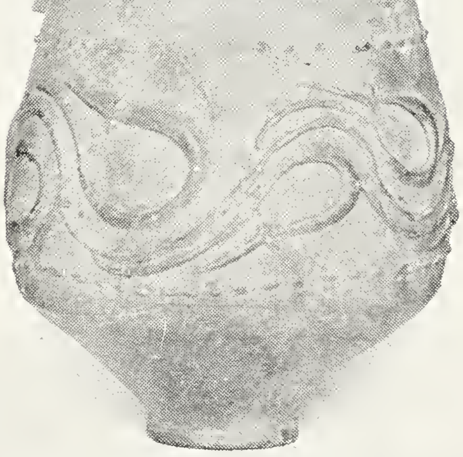
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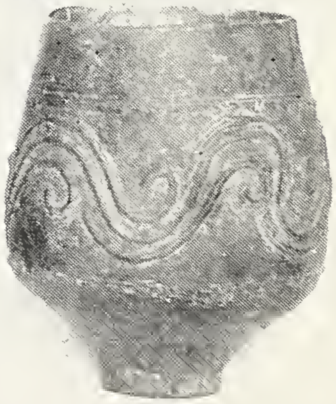
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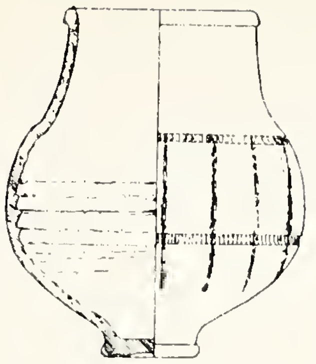
Vessels with Coloured Coating (Barbotined).

XI



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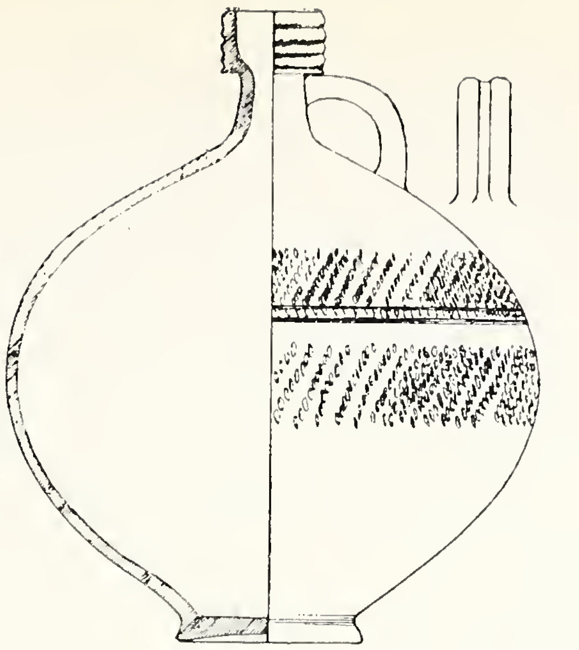

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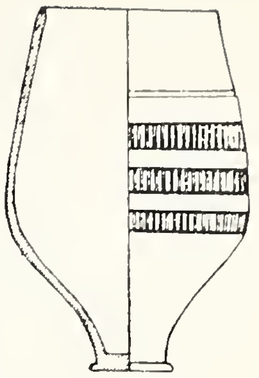

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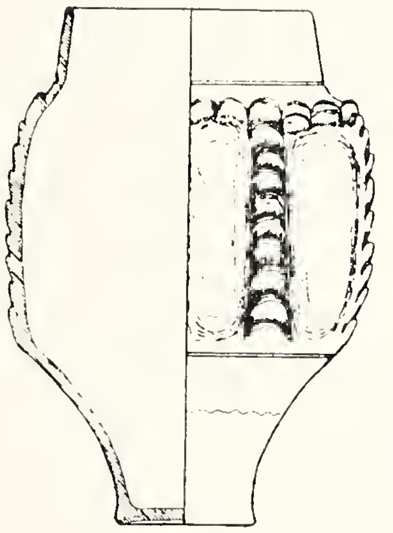

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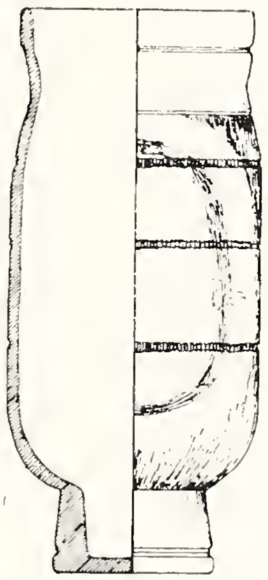

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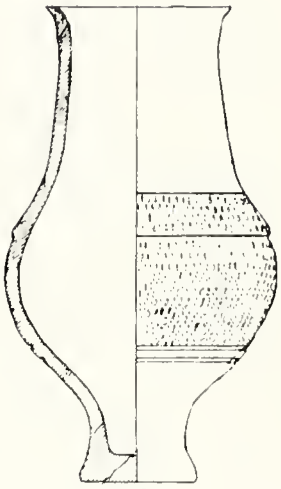

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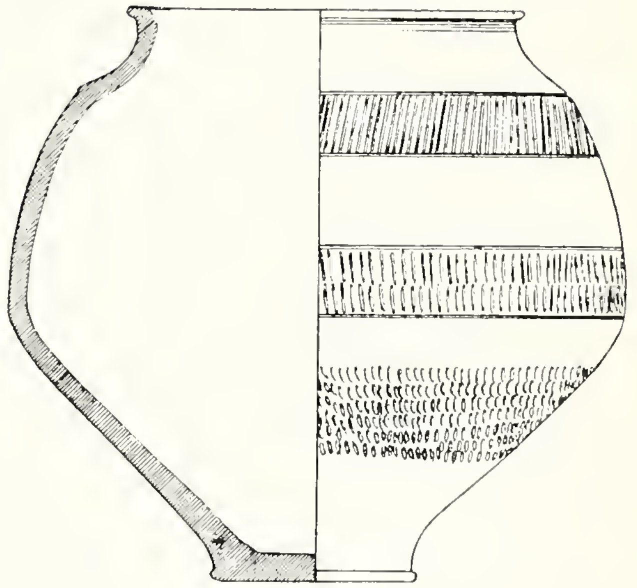

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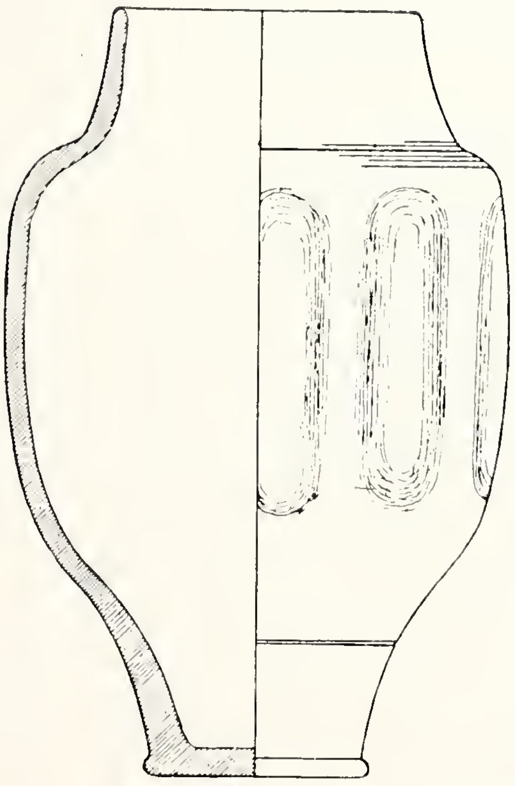

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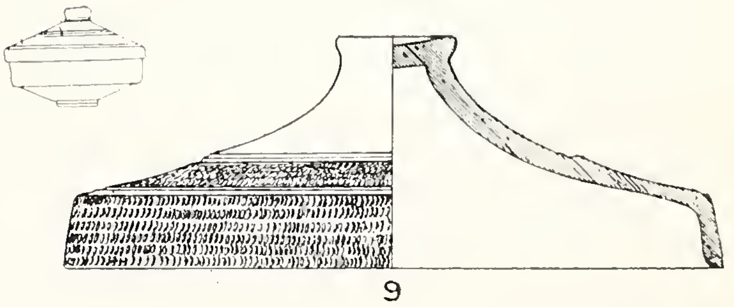

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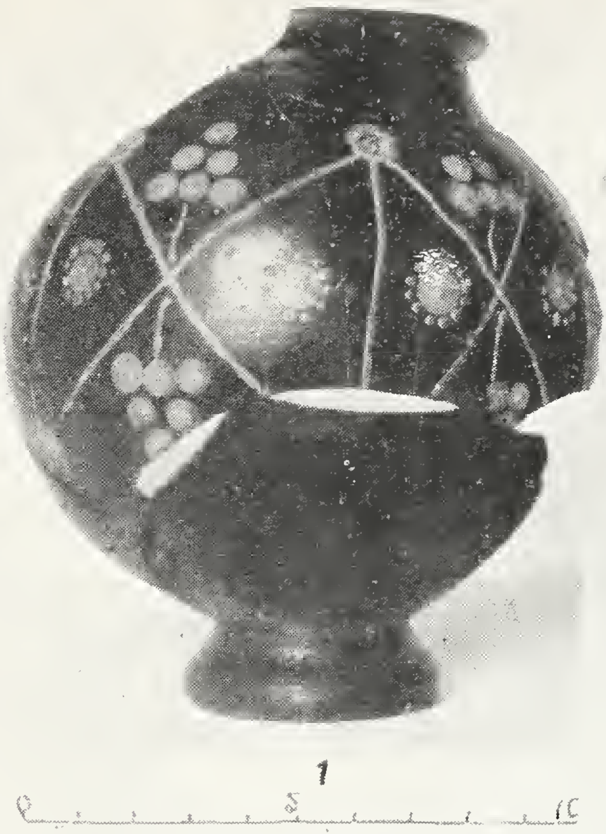
Colour Coated Wares (Folded and Roulette Notched). (Size $\frac{1}{4}$).

BRITISH MUSEUM NATURAL HISTORY

XII a



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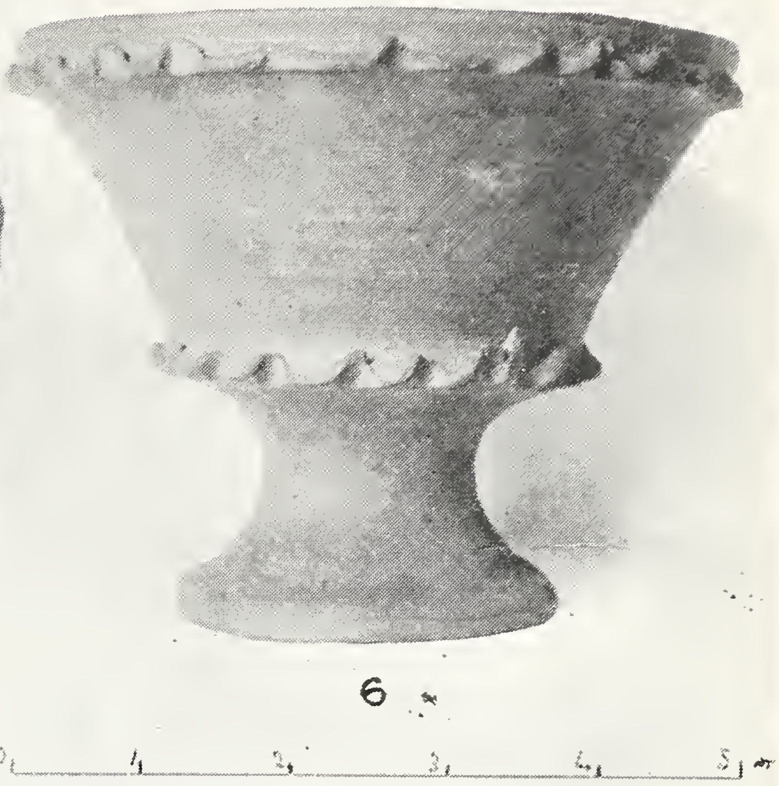

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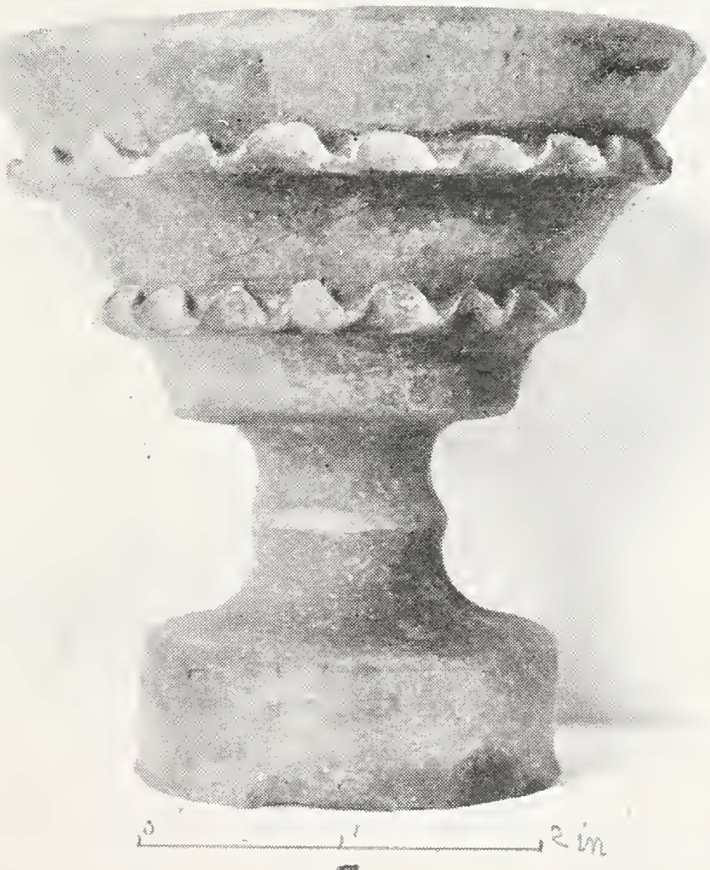

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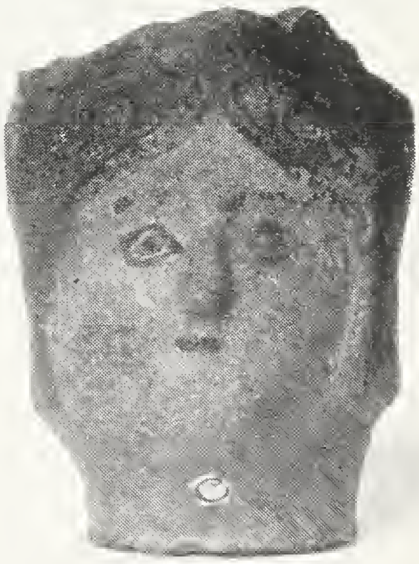

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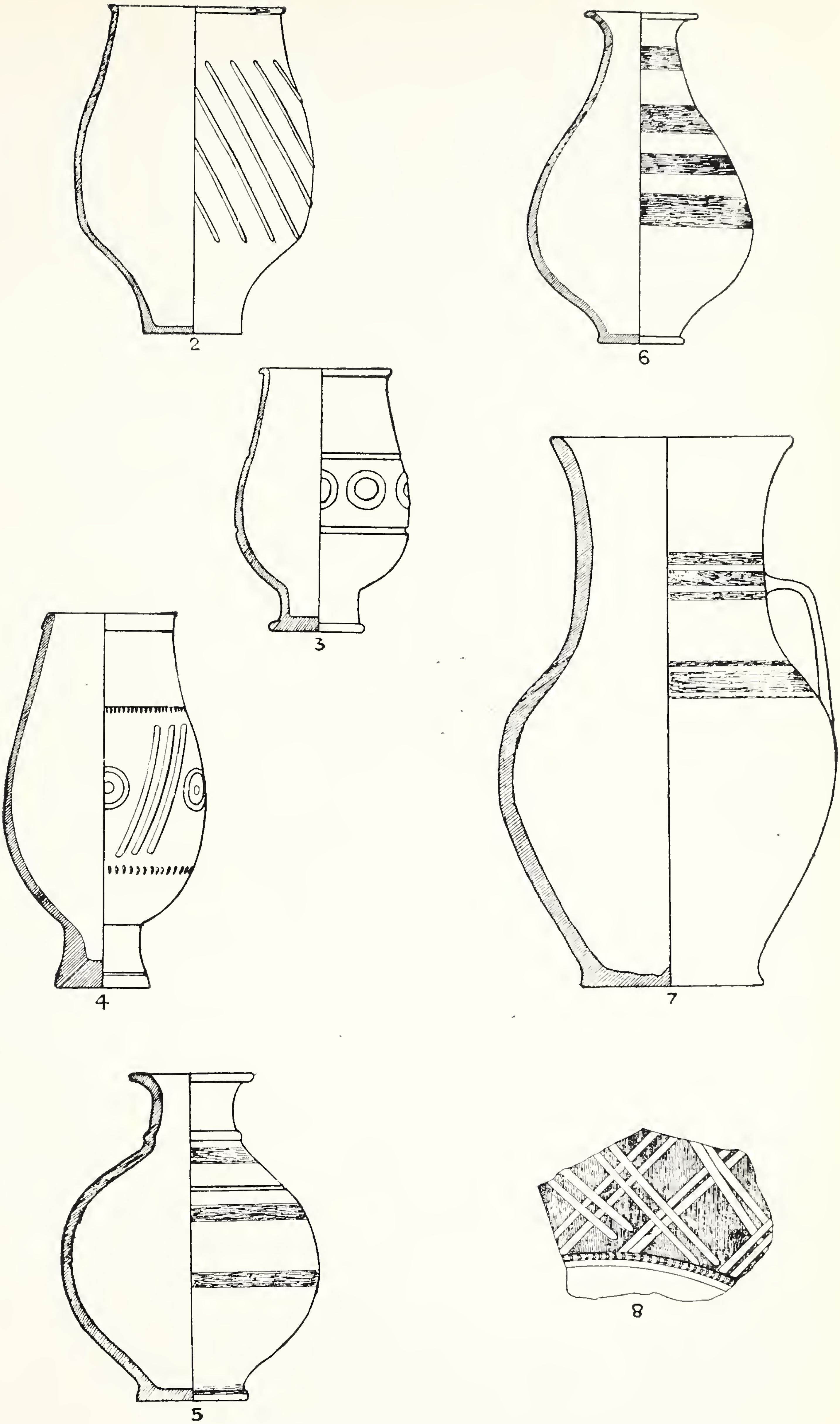
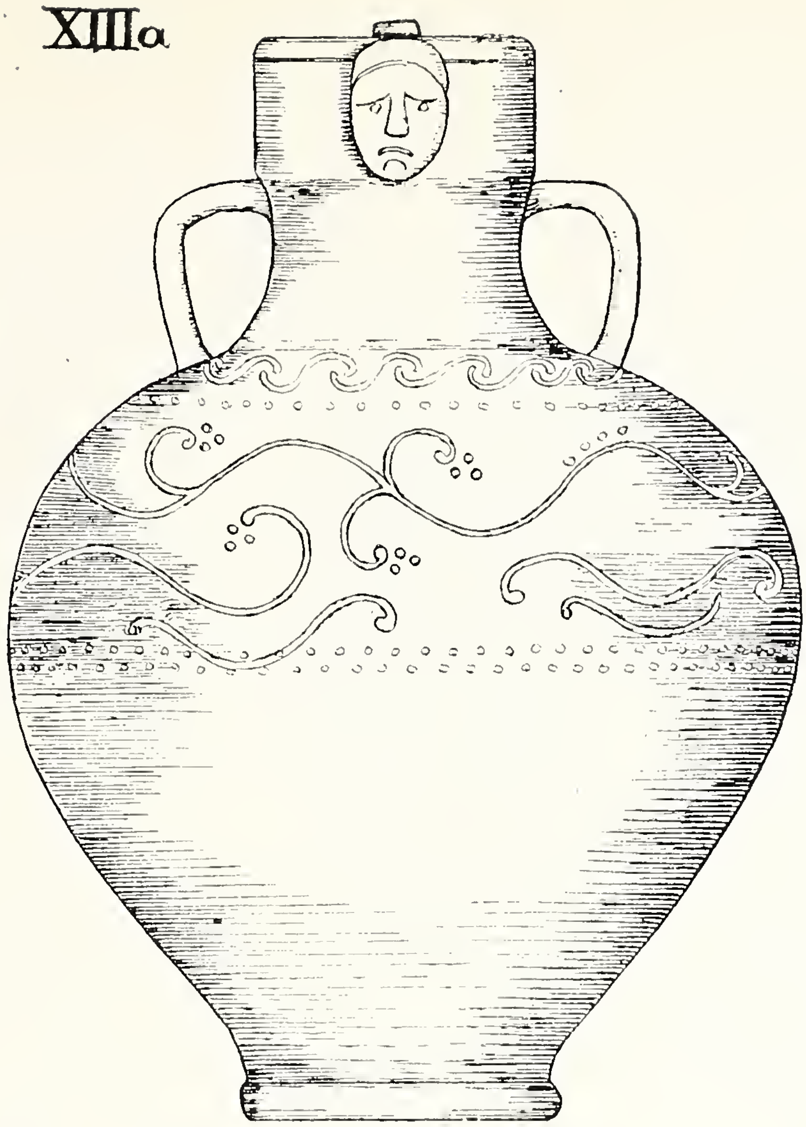
Colour Coated Vessels.

XIIb



Painted Vessels. (Size $\frac{1}{3}$).

XIIIa



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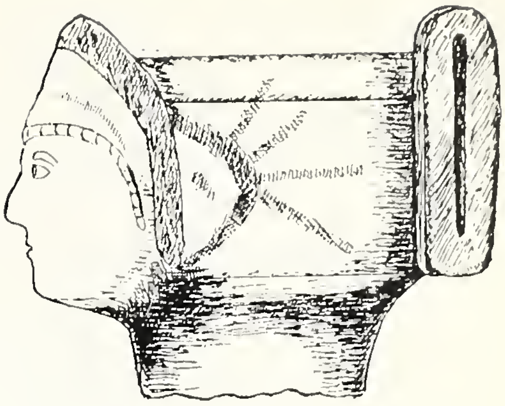

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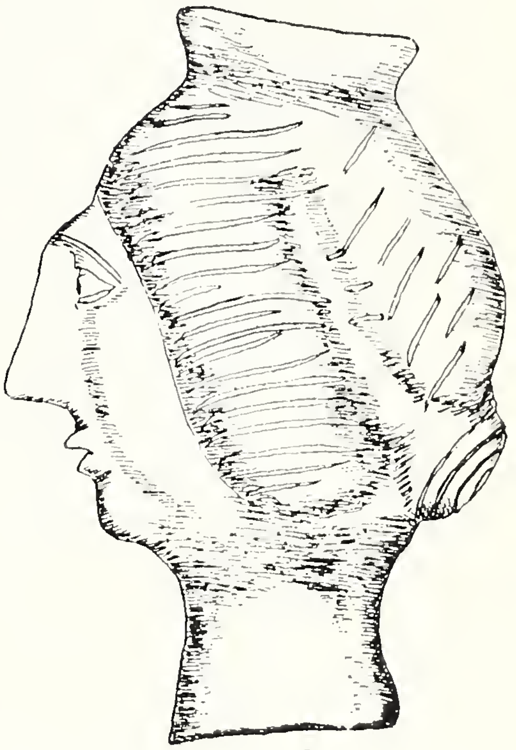

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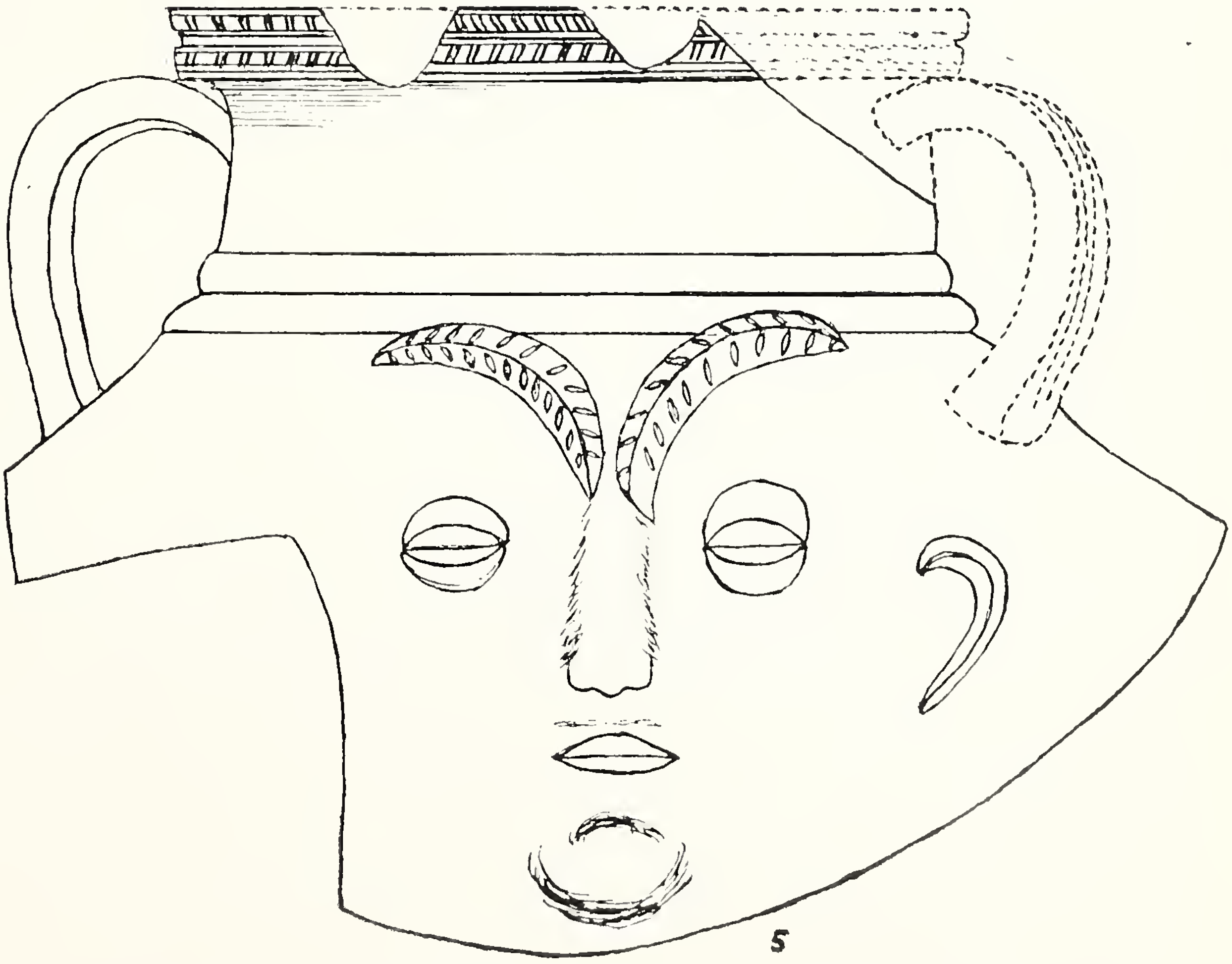

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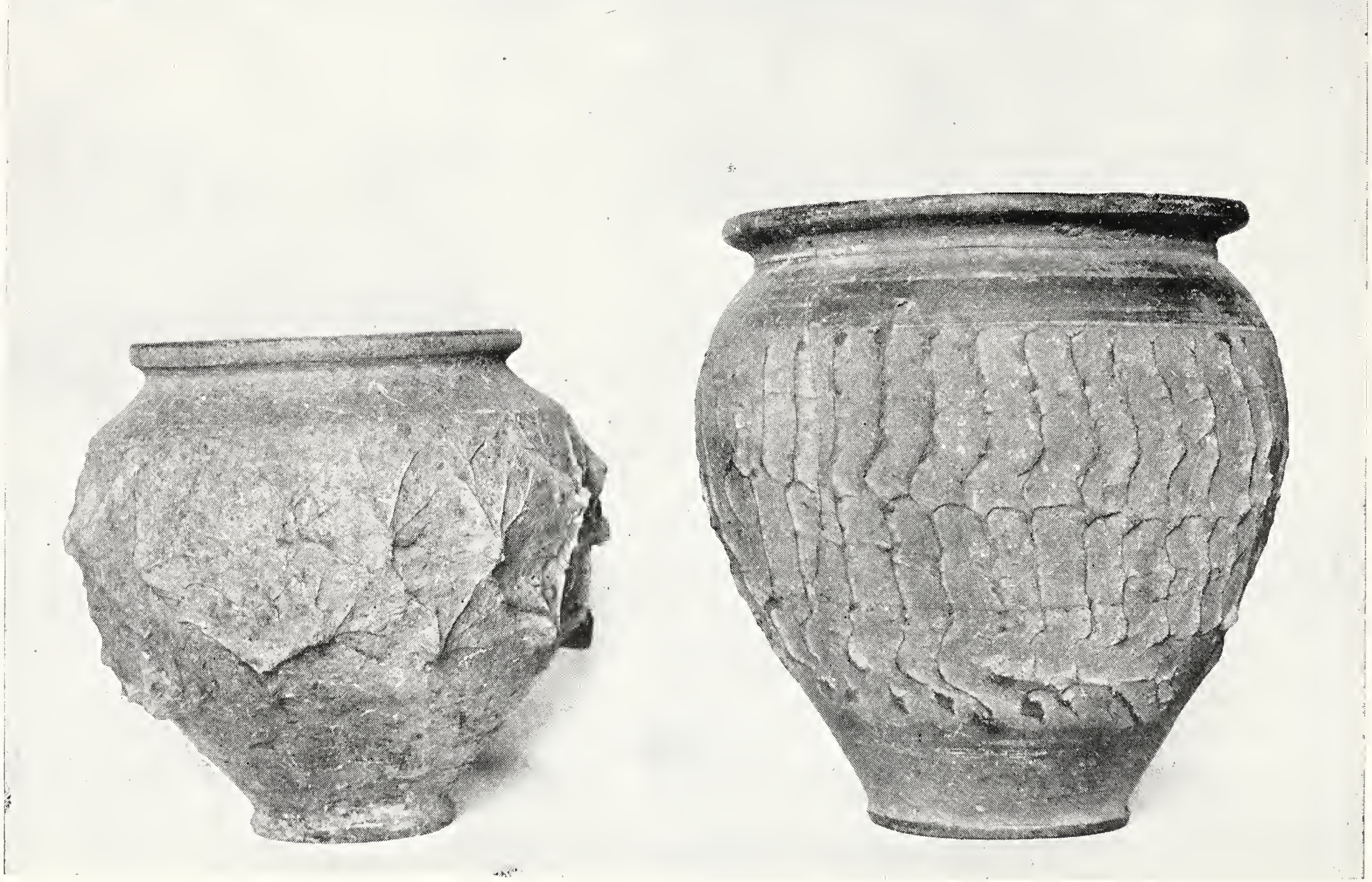
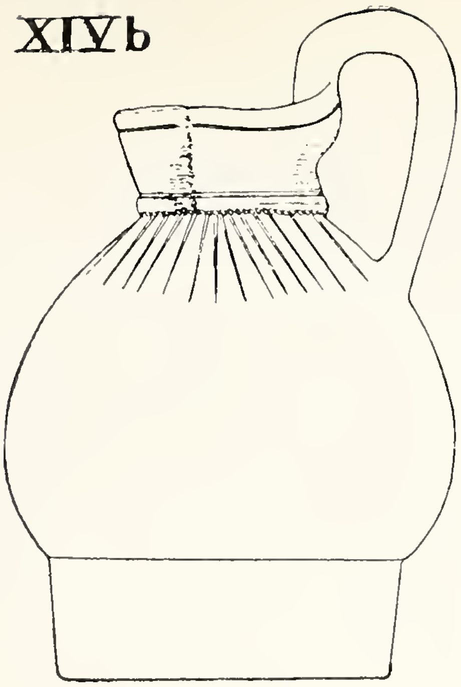
Face Vases. (Size ½ except No. 1 which is ¼ Size).

XIVa



Fumed Vessels (Ridged).

XIVb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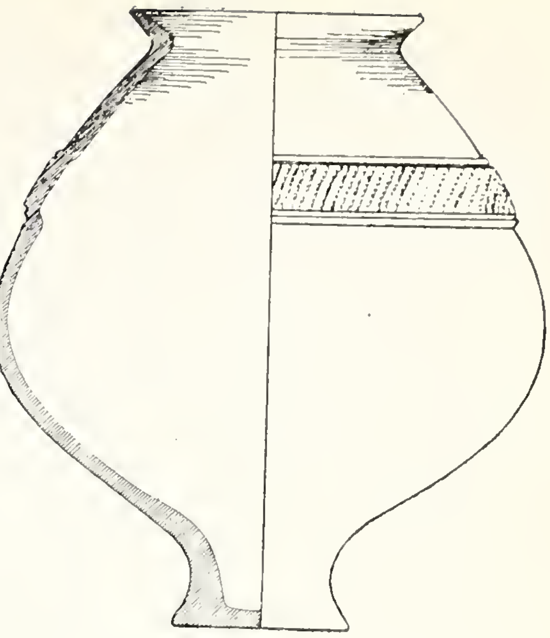
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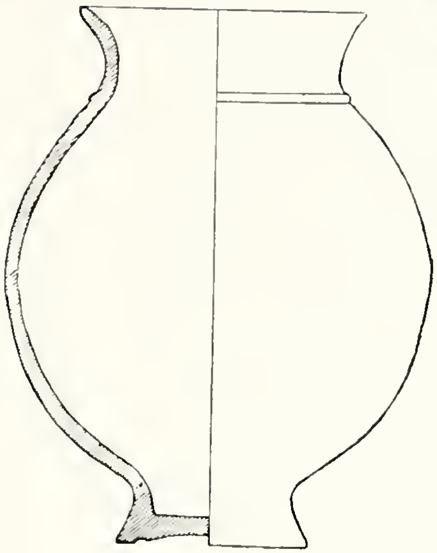
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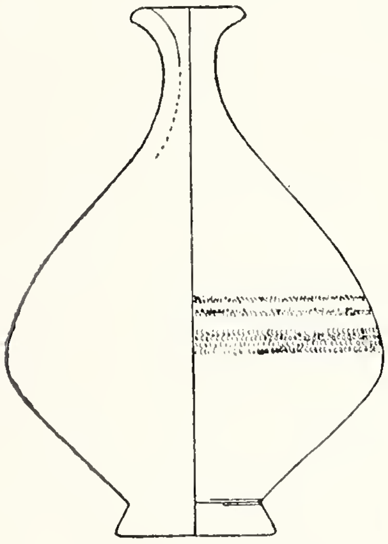
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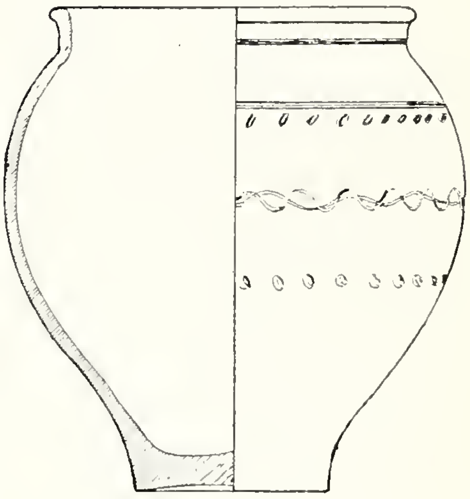
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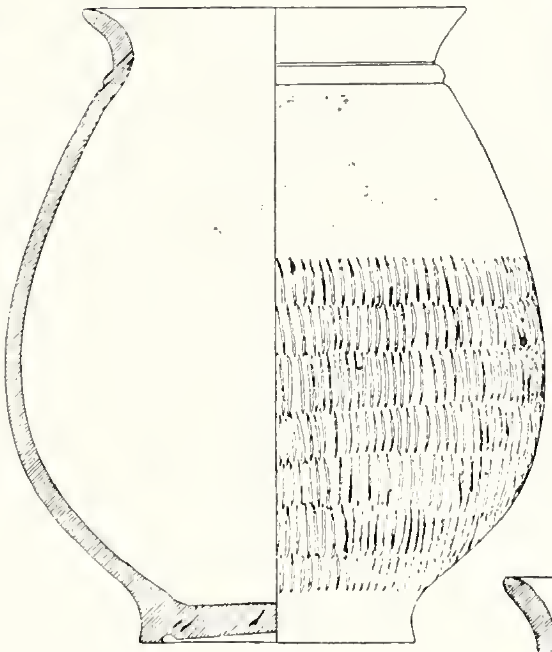
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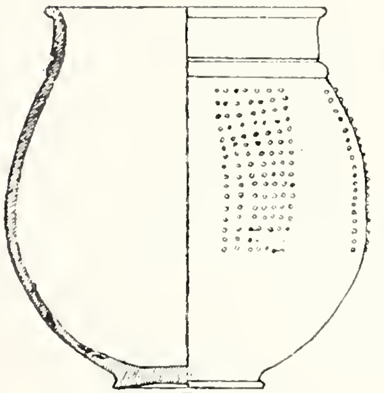
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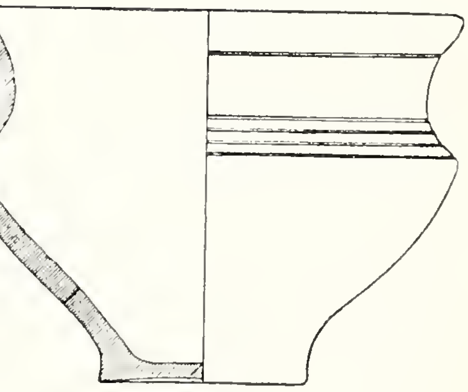
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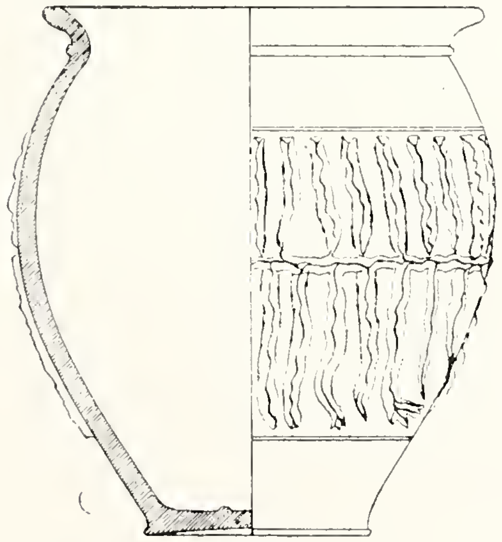
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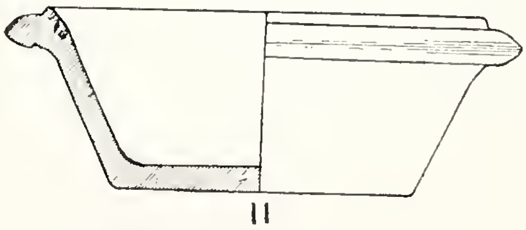
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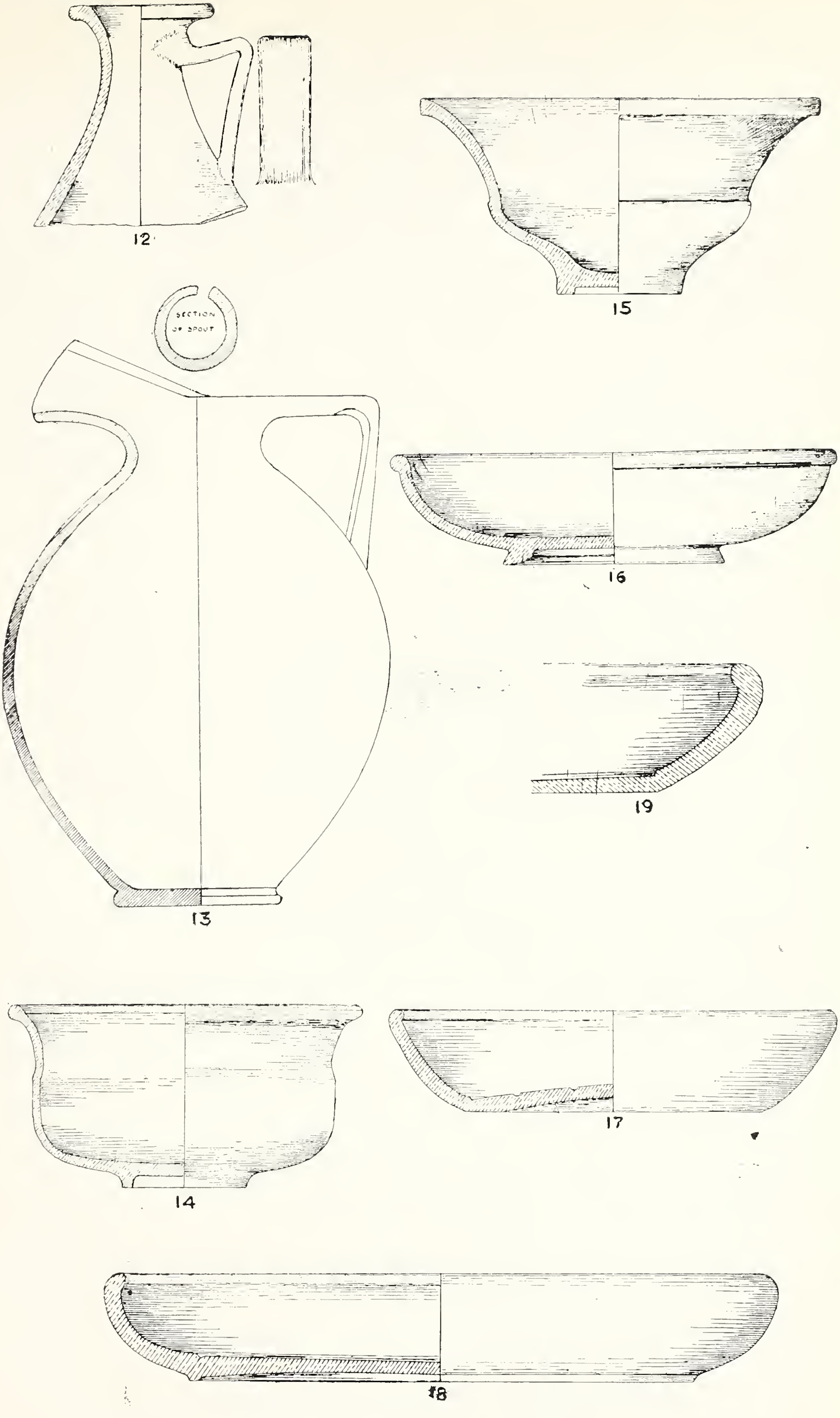
Fumed Wares. (Size $\frac{1}{4}$).

XV



Belgic Red Wares. (Size $\frac{1}{3}$).

BRITISH MUSEUM
NATURAL HISTORY

YORK PHILOSOPHICAL SOCIETY'S MUSEUM.

Proposed New Lecture Theatre.

The Theatre of the Museum has for several years been a subject of grave concern to the Council of the Yorkshire Philosophical Society. Though larger than most of the theatres belonging to the principal London Societies, it is often inconveniently overcrowded. This state of things is now in a fair way of being remedied. The President of the Society, Dr. Tempest Anderson, has decided to apply to the building of a new theatre a sum of money left to him by his sister, the late Mrs. Percy Sladen, to be used for some scientific purpose.

The well of the present theatre will be floored over, and this hall will thus become available as a reception-room for use before or after the lectures, and also for smaller meetings. The space behind the pillars will also be available for show cases, and it is hoped that some local collections in the county may eventually find their home there.

The new theatre will be built at the west side of the present building, space being reserved in front of it for a further enlargement of the Museum; it being undesirable to extend further in the direction of the Abbey. In deciding to build the new theatre on the west, in preference to the east side, the Council were much influenced by the facility thereby provided of utilising the basement as a covering for the ruins of the vestibule of the Abbey Chapter House, which have suffered much from exposure to the weather. These ruins are considerably below the proposed floor level of the theatre, consequently the basement can be well lighted and ventilated, and it will provide an admirable hall for the display of the whole of the mediæval stone remains which now crowd up the Roman antiquities in the lower storey of the Hospitium. The external wall foundations of the vestibule will be utilised for the new building, and a few additional columns of light construction will be provided in suitable positions to assist in supporting the floor of the theatre, but to show that no objectionable interference with the ruins need be feared, it may be pointed out that the scheme has received the approval of the "Society for the Protection of Ancient Buildings."

The proposed theatre will be about 79 feet long and 47 feet wide, and will comfortably seat nearly 400 people. Between the higher tiers of the seating and the basement hall, a workroom (39 feet by 26 feet) will be provided. The outer walls, floor, and roof are to be constructed of ferro concrete, and the whole structure is designed to harmonise with the existing building, although the architectural features of the front elevation are necessarily limited by the facility, previously mentioned, provided for a future extension of the Museum. This addition is not probable in the near future, but in the meantime the existing shrubbery will effectively screen the lower part, while revealing the architectural ornament and detail near the skyline of the building.

Access to the new theatre will be obtained from the left hand side of the present theatre, which, as previously mentioned, is to be converted into a central or reception hall, by an enlargement of the present door into one of the galleries of the Museum, known as the Tertiary Room. This gallery is quite narrow, and a new door, opposite the one just mentioned, will lead directly onto the floor of the new theatre, near the lecturer's table. Another new doorway from the lobby outside the present Council room door will also give access to the Tertiary Room and provide an alternative road to the theatre when the central hall is required for other purposes, but its chief object is to obviate the long walk at present taken through the cellars by the lecturer and council. There will also be a small door at the back of the theatre which will be available for the inevitable late comers without disturbing the audience. The floor of the theatre will rise upwards towards the back of the Museum, not quite as steeply as the present one, the majority of the steps being 3 ft. 6 ins. wide, which will allow space for considerably wider and more comfortable seats than those of the present theatre, where the steps average about 2 feet in width. A projecting porch, approached by a flight of steps, gives access to, or exit from, the lecture theatre, and the lower hall or "vestibule" can also be entered from the gardens as well as from the present Museum.

The treatment of the interior of the lecture theatre is in the Grecian Ionic style; lofty pilasters with ornate capitals are arranged along the face of the walls about 8 ft. apart, and give support to the main beams of the roof and ceiling. The lower part of the walls, up to 10 feet high, is to be covered with oak parquetry, behind which is placed a sheeting of asbestos—a precaution taken against both fire and damp—and it may also be mentioned that all the doors are similarly treated. The floors and steps are to be covered with cork carpet. The ceiling is divided into large panels with deep moulded and panelled beams, which will largely add to the achitectural effect of the interior. The "lantern screen" will be behind the lecturer at the south end of the theatre. The artificial lighting will be chiefly by electricity, and switches controlling the whole will be arranged close to the lantern operator. Large windows are placed high up on each side, and will be readily darkened by curtains. The warming of the theatre, lower hall, and work-room, will be by low pressure hot water, large radiators being placed at convenient points along the walls, with inlets for fresh air behind them. A constant supply of fresh air will be thus provided, whilst the foul air will be discharged by an extraction shaft and ventilator on the roof, to which will be added an electric fan as an auxiliary, if found necessary. The plans and the structural arrangements provided for fire risks have been approved by the Streets and Buildings Committee of the Corporation, and the Chief Constable of the City.

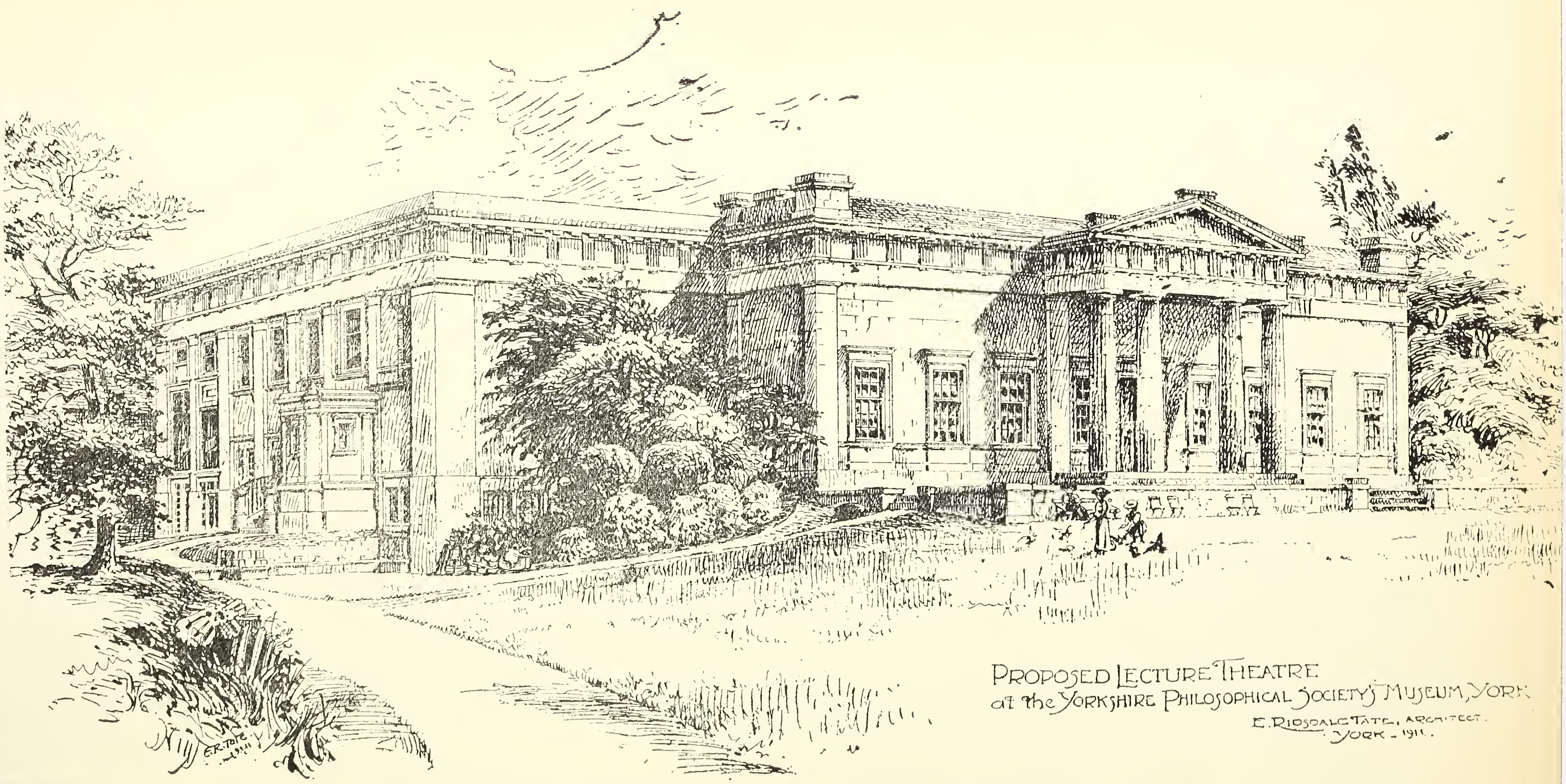
An early start is to be made with the building, which has been designed by Mr. E. Ridsdale Tate, architect, York.

The Existing Museum.

One of the chief titles to distinction possessed by the existing Museum building is the fact that it was the birthplace, eighty years ago, of the British Association for the Advancement of Science. The Yorkshire Philosophical Society had then been in existence for some seven or eight years. It was founded in 1823, the motive power for its establishment having been found in the discovery of the celebrated Kirkdale Cave, near Kirbymoorside, with its wealth of ossiferous remains. These fell into the hands of three York gentlemen—Mr. Jas. Atkinson, Mr. William Salmond, F.G.S., and Mr. Anthony Thorpe—who, considering that such treasures, when dispersed in private cabinets, lose much of their value, concurred in a resolution to unite them in one collection as the basis of a Yorkshire Museum of Natural History and Antiquities. Thus the Yorkshire Philosophical Society came into existence. It may be mentioned that a scheme for a municipal museum had been proposed to the Corporation in 1743, by Mr. John Burton, M.D., F.S.A., who offered to the city a valuable collection of Charters and other antiquities if a suitable repository should be found. The offer was declined and the collections lost.

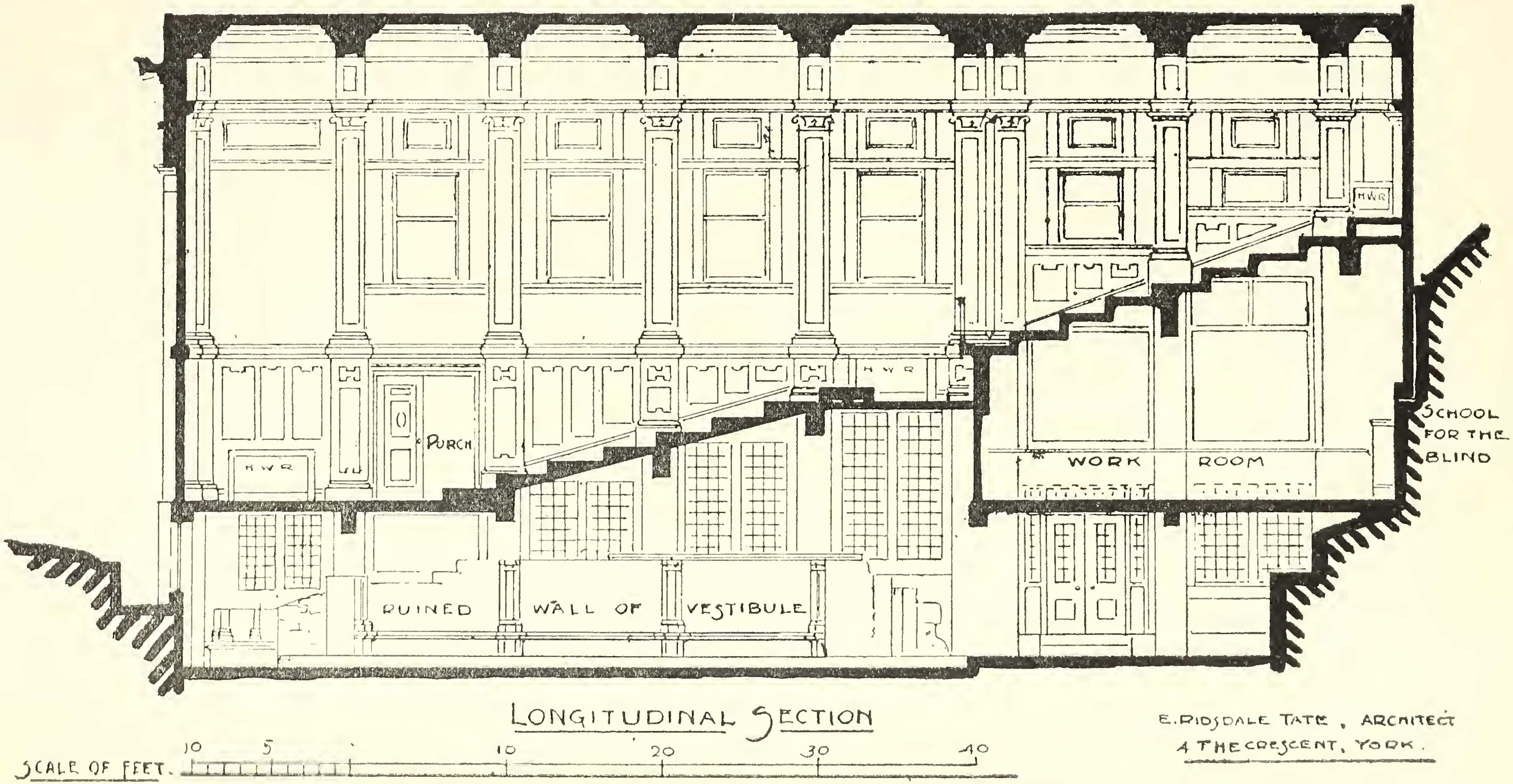
It was Wm. Vernon Harcourt, whom Dean Peacock styled "the lawgiver and proper founder of the British Association," to whom the citizens of York and many others are indebted not only for the establishment of the British Association, but for the foundation of the Yorkshire Philosophical Society. He was its first President. His exertions secured the land on which the Museum stands, and a large part of the gardens, which now form one of the chief ornaments of the heart of the city. What is now the Museum Gardens was in his time a waste piece of ground, called the Manor Shore. The ancient ruins of St. Mary's Abbey were defiled by the vicinity of pigsties and cowsheds, and told of desolation and neglect. It was on Mr. Harcourt's application, supported by the influence of his father, the Archbishop, that the Crown made the original grant of the land to twelve Trustees, of whom he was the last survivor, for the purposes of the Society. Under his auspices the subscription to the Museum Building Fund was commenced, which ultimately reached £9,000. The present building, begun in 1830, was in 1831 in a state of sufficient completeness to receive within its walls the members of the British Association that was to be. The Museum occupies one of the finest and most historic sites in York, on the crest of the hill, between the King's Manor and the river, with the old Roman Wall and the Multangular Tower and St. Leonard's Hospital on one side, and the ruins of St. Mary's Abbey on the other.

The Yorkshire Philosophical Society has done much to throw light upon the history and conditions of Eboracum by gathering in its museums, mainly in the Hospitium, in ancient days part of the domestic offices of St. Mary's Abbey, a very large collection of objects illustrative of Roman manners and life. There is no collection from any Roman site in Britain that can be compared with it. More than fifty inscriptions are preserved—funereal and votive. Between thirty and forty huge stone cists are in the grounds of the Society, with examples of almost every kind of interment in use among the Romans. Nearly 700 urns, most of them made on the spot, and of all forms, are shown in the Museum, with a multitude of other objects, including the auburn hair, "flavus crinis," of a young Roman lady taken out of her coffin, and still ornamented with the pins of jet she used in life. The reign of Trajan is represented in the Museum by an inscription, cut in the year 108-9 of our era, recording the completion of some work of the Ninth Legion, dedicated by them to the Emperor. It was, says Canon Raine in his History of York, probably the palace or some building of great importance which may have been built by the order of Trajan himself. There are also memorials of Hadrian, Severus, Constantine, and other great Romans.



PROPOSED LECTURE THEATRE
at the YORKSHIRE PHILOSOPHICAL SOCIETY'S MUSEUM, YORK
E. RIDSDALE TATE, ARCHITECT.
YORK - 1911.

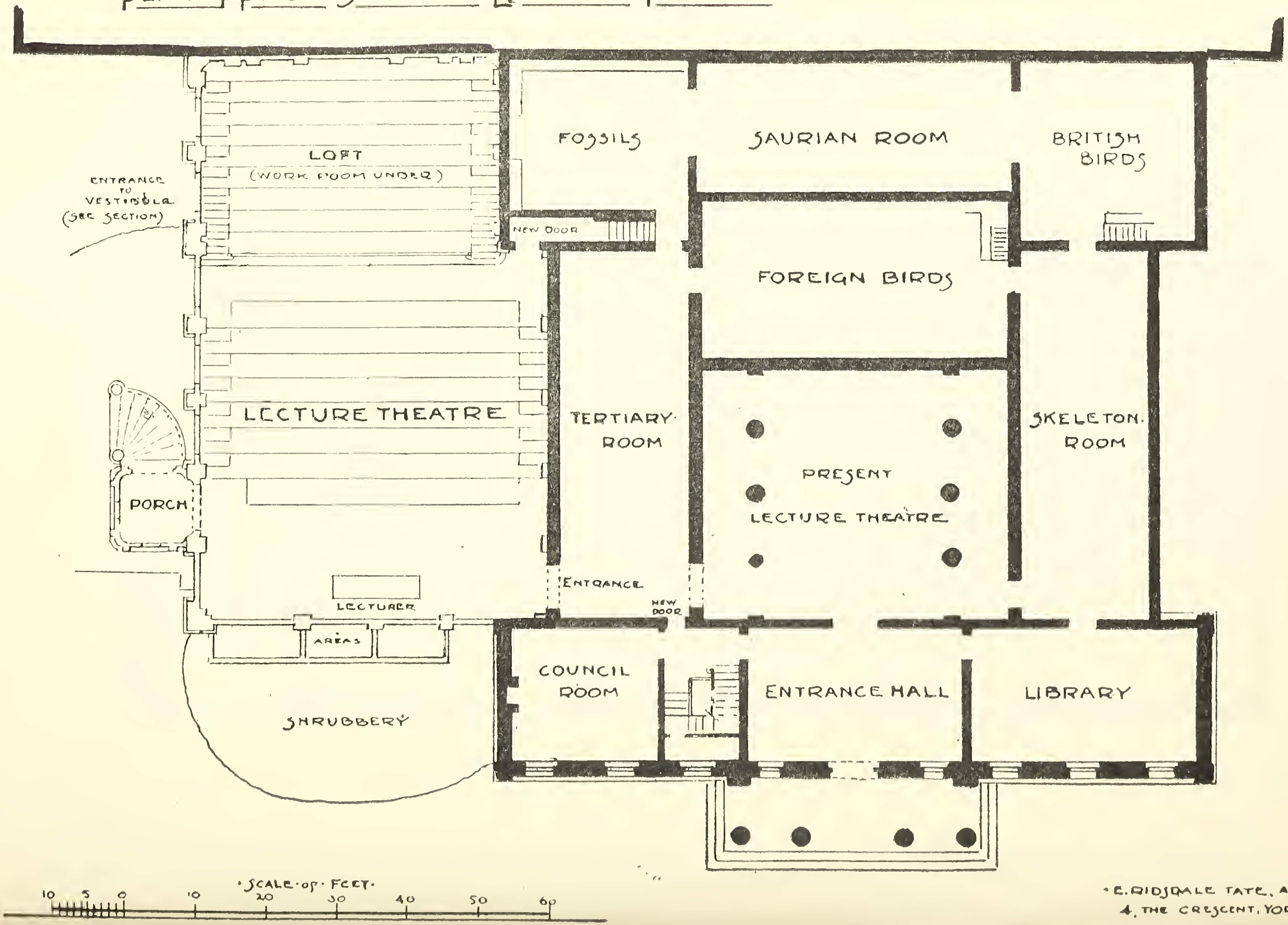
- PROPOSED NEW LECTURE THEATRE -
- AT THE YORKSHIRE PHILOSOPHICAL SOCIETY'S MUSEUM. YORK -



LONGITUDINAL SECTION

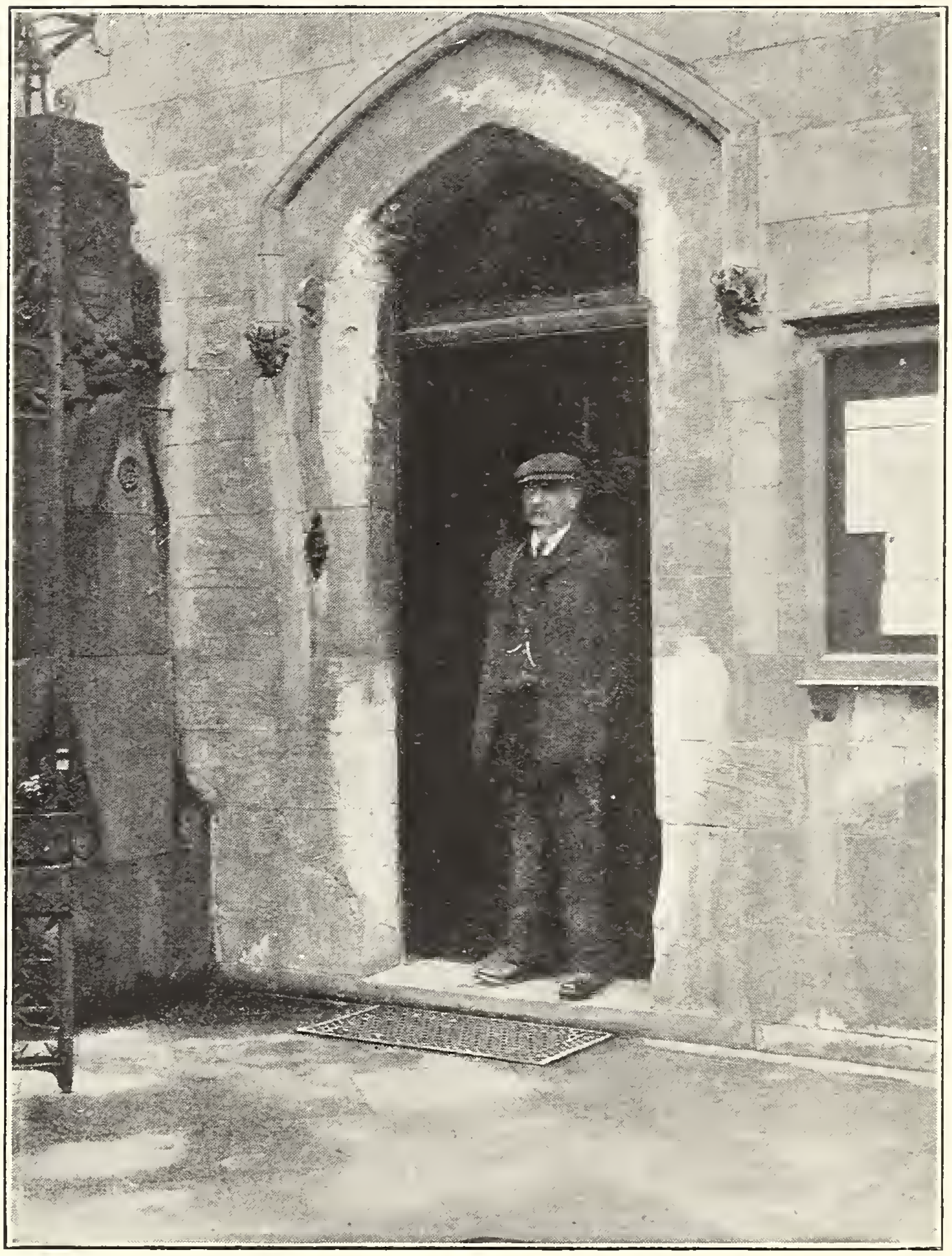
E. RIDSDALE TATE, ARCHITECT
4 THE CRESCENT, YORK.

THE MUSEUM YORK
· PLAN of PROPOSED NEW LECTURE THEATRE ·



· E. RIDSDALE TATE, ARCHITECT ·
4, THE CRESCENT, YORK.

Plate VII.



T.A. Photo.

DISEASED STONE, EARLY STAGE.

Gatehouse, York Museum.

Reprinted by permission from "The Museums Journal,"
October, 1910.

THE DECAY OF STONE ANTIQUITIES.

By Tempest Anderson, D.Sc., President.

(*Read at the York Conference,* 1910.)

(Plates VII., VIII.)

The antiquities in the Museum Gardens at York have during the last few years shewn serious signs of decay. In this they are not singular; the Houses of Parliament, York Minster and many, perhaps most, stone buildings in towns are more or less affected, so that the question is of almost national importance.

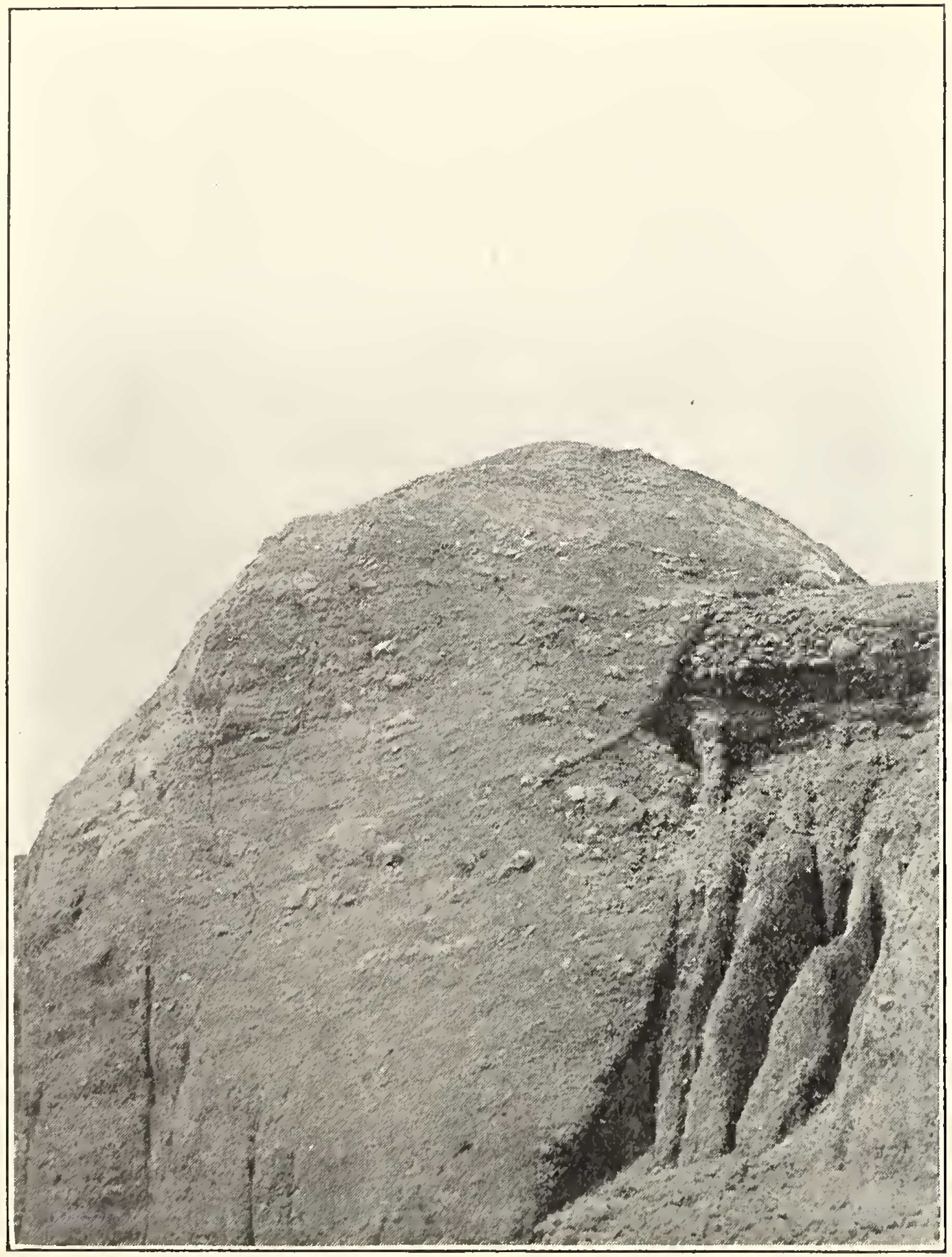
The cause has been put down to smoke, sulphuric acid from burning coal, and other causes; waterglass, limewash, baryta water, and many other applications have been tried without any success, and the disease still spreads. Our stone is a magnesian limestone. Some years ago some objects in the lower storey of the Hospitium first began to be attacked; our Council, acting on expert advice, decided that more air was required, and a grating was applied to the doorway, so that the door could be kept open, but no benefit has resulted. At present the cry is that the cause is wind action, and windows have been put into parts of St. Leonard's Hospital. These two views cannot both be right. The inside also of St. Leonard's Hospital, on the best expert advice, was washed over with limewash about three years ago, but it has all peeled off, and the entire inside surface, instead of being a mellow brown, is now one mass of whitish crumbling dust.

Wind action is a well-recognised geological agent, and among its effects a polishing of the surface of the stone is mentioned in most text-books. It can polish concave surfaces as in the well-known Dreikanter (three-cornered stones) of the Egyptian and other deserts, and this has been claimed as characteristic of wind action.

It so happens that, years before this idea of wind action was introduced here, I had paid considerable attention to the question of wind erosion, and had taken photographs of such examples as I met with in the deserts of Iceland. The best specimen (photograph shewn) was a surface of soft tuff or consolidated volcanic ash with larger fragments of harder stone embedded in it. The hard, sharp sand driven by the strong wind had eaten away the soft tuff, leaving the harder blocks standing up, and, the prevailing wind having come from one direction, the lee side of the stones had escaped and a tail remained behind each of them. The action was entirely a surface one, and the stone that remained was sound and uninjured; no crumbling was noticed.

I saw some very striking examples of wind action on the new ash of the 1906 eruption of Vesuvius. The old lavas near the observatory were covered with a layer a few feet thick. It had fallen gently and was in well-defined layers of slightly different appearance and from half an inch, or even less, to a few inches thick. When I was there a few days after the eruption, the deposit was rapidly consolidating. The wind carried the loose sand forcibly with it, and was planing off the projecting parts, exposing beautiful sections of the different layers. It was entirely a surface action. The parts which remained were entirely untouched and unaltered. I have seen the same thing on Haleakala, the great dormant volcano in the Hawaiian Islands.

Plate VIII.



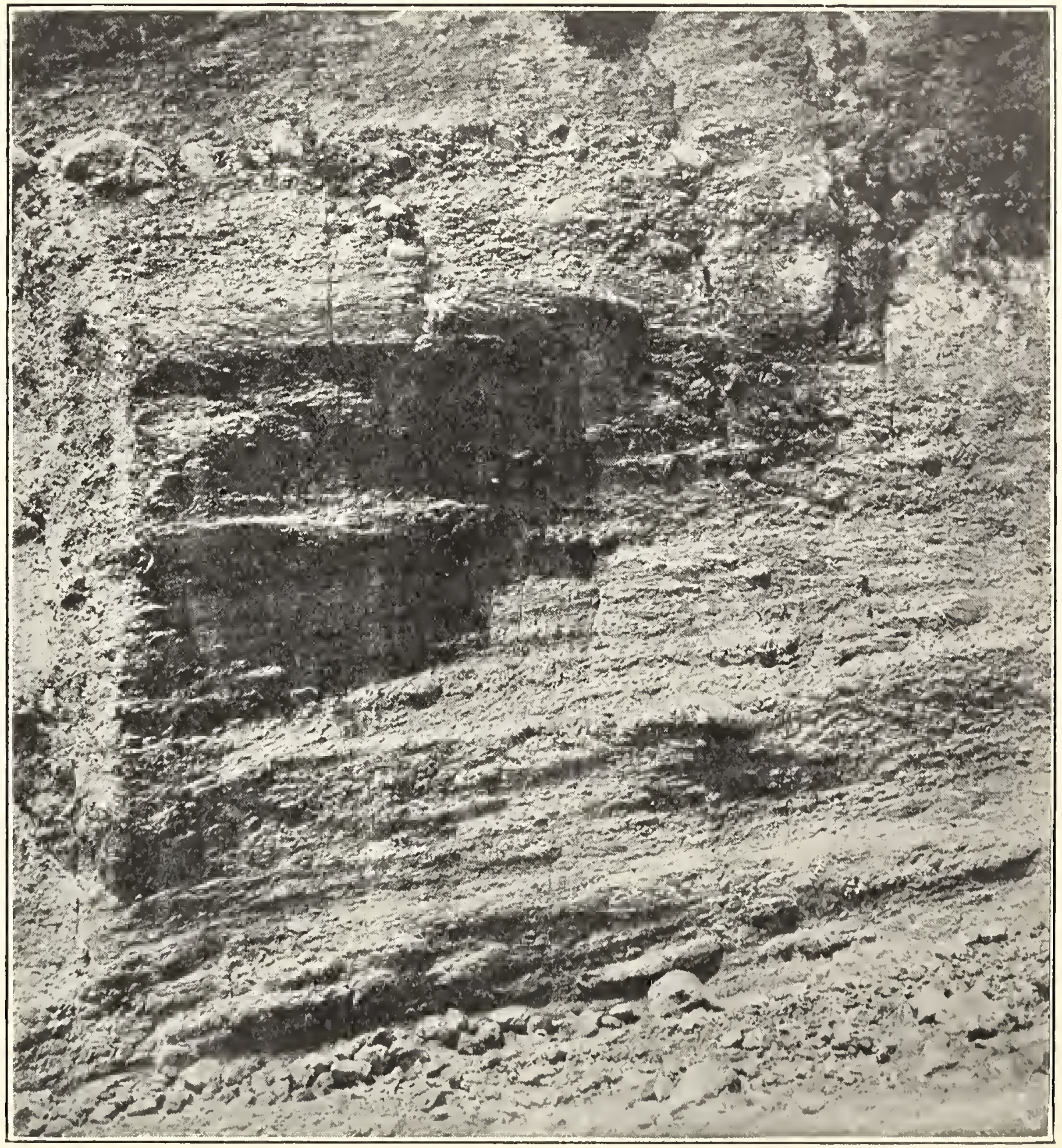
T.A. Photo.

Fig. 1.

MONTAGNE PELÉE.

Tuff-agglomerate scored by "Hot Blast" Avalanches.

Plate VIII.



T.A. Photo.

Fig. 2.

Details beyond left corner of Fig. 1.

In July, 1902, I saw, at quarters too close to be pleasant, along with Dr. Flett, the descent of one of the Incandescent Avalanches similar to the one that destroyed St. Pierre in Martinique, and brought forward the theory of the hot blast, which at first met with much opposition, but is now generally accepted. Briefly it is believed that the hot lava or magma, rising in the chimney of the volcano, is highly charged with gases and vapours which are retained in solution by the pressure. When it gets vent and the pressure is relieved, the whole is blown to pieces by expansion of the gases, and the result is a mixture of incandescent fragments, minute or larger, suspended in a mixture of gases and vapours also incandescent, which rolls down the mountain side by the force of gravity with the weight of a liquid and the mobility of a gas.

In 1907 I revisited Martinique and walked a considerable distance up the valley, down which the avalanche descended. I saw the rocks grooved and scratched by the avalanches and hot blast which had repeatedly passed over them. The grooving thus produced, which much resembles glacial scratchings, is figured in Part II. of the Report to the Royal Society, published in the *Philosophical Transactions* for 1908, and the photographs are here reproduced in Plate VIII. It is entirely a surface action and the rock beneath is not decayed or crumbling, and it is in all respects different to the crumbling of our antiquities.

Now the disease from which our stones are suffering is not a generalized surface abrasion like the above. It is as strictly localized and circumscribed as a ringworm, which is a well-known parasitic disease, the part outside the border being absolutely free and unabraded, while the part inside is depressed, and the whole floor of the cavity is formed of a crumbling mass of grit. It would be impossible to find anything more different from the examples of wind action described above. It is not a surface action at all, but, I believe, a decay or rot affecting the substance of the stone, and, like other decays and rots, is in every probability caused by the action of some low organism, like the moulds and fungi which rot wood, canvas and other vegetable materials.

About two years ago, to test this view and endeavour to find a cure, as all efforts based on the abrasion or chemical theories had failed, I had affected stones treated with various germicides, and the stones which have since best resisted the decay were three then treated with sulphate of copper (5% solution), bichloride of mercury, and creosote.

It will be remembered that copper sheathing and copper nails are used to prevent the decay of the bottoms of wooden ships, and sulphate of copper is the preservative used in the manufacture of the well-known Willesden rot-proof canvas. It is also a very powerful germicide, and would be more commonly used in ophthalmia and other bacterial eye diseases were it not that it causes severe smarting. Various preparations of copper are used by scientific agriculturists and foresters to destroy blights and moulds on vegetation. Bichloride of mercury is much used as a germicide in surgery. Creosote is extensively used for preserving timber.

I shewed Prof. Boyd Dawkins our ruins and the trial stones, and he said that it seemed like the localized action of some acid, and agreed that it was quite possible that some low organism might secrete acid or other material capable of disintegrating the stone, though this was the first suggestion of this cause he had heard, and finished by saying that this was, he thought, the most likely source of the acid. The town-soot, dirt, and other impurities might form a nidus in which it could develop, and the damp to which all outdoor stones are necessarily exposed, and which, in the case of the Hospitium, has never properly dried out since the great flood of 1892, would doubtless contribute. Most low organisms cannot grow if deprived of moisture.

I then asked Mr. Ryan, F.I.C., the chemist to the York Waterworks, to do me a cultivation of a little of the dust in the same way as in water analysis. He did so, and he produced a plate cultivation with thousands of colonies.

(Three tubes of such cultivation were exhibited, and the writer asked assistance from any botanists or bacteriologists present in identifying them.)

The next step will be to apply some of these cultivations to a piece of healthy stone and see if the disease can be inoculated. Meanwhile, I strongly advise the application of sulphate of copper to a larger piece, and that means be applied to the Hospitium to keep it perfectly dry, such as a stove inside and an embankment and valve to keep out the floods which happen every few years, and one of which has not recently occurred.*

DISCUSSION.

Mr. H. Bolton said that in the Bristol district the Bath stone which was much used as a building stone, had to be carefully handled as it bruised readily, and in that way offered facilities for weathering agents to operate.

Mr. T. Sheppard laid stress upon the action of carbonic acid in destroying stone. By far the greater amount of erosion which went on in the district from which he came was due to the influence of the weather.

Mr. H. M. Platnauer said that in considering the respective actions of carbon and sand they must take into consideration the fact that one was oxydized and the other was not. He must deprecate any comparison between the action of organisms on wood and stone, for the very simple reason that one was purely organic and the other was not.

Mr. E. E. Lowe mentioned the conditions existing at Croft, near Leicester, where the syenite is decomposed to a depth of more than eight feet, and thought that the agents producing such an extensive decomposition should be taken into consideration.

Mr. E. M. Holmes remarked that the disintegration of the stone might be due to the action of carbonic acid in dissolving the carbonate of lime in the presence of rain, and leaving the carbonate of magnesia in the stone in a crumbling state. This action could be seen at Roker, near Sunderland, on the magnesian limestone rock. Some lichens secreted oxalic acid; others, especially of the genera *Verrucaria* and *Lecidea*, eroded limestone rocks, and it was quite possible that the early stages of such lichens might be present in the stone, as the spores of lichens were constantly present in the air, and the algal portions of lichens were killed by a solution of sulphate of copper, which might account in part, at all events, for the results obtained by Dr. Anderson. It would not be possible to determine the nature of the cultures shown by Dr. Anderson in the tubes, without microscopical examination. One tube seemed to contain the mycelium of a fungus, but that might be due to imperfect sterilization. With respect to the weathering of syenite mentioned by Mr. Lowe, he could only say it appeared to depend on the amount, and condition, of the felspar present, the result of the action of water being the crumbling of the rock, and the setting free of the disintegrated felspar in the form of china clay. He believed that in large manufacturing towns the presence of hydrochloric acid from chemical manufactories frequently injured limestone buildings, as in the case of the Houses of Parliament. The natural tendency of soot was to contain antiseptics such as creosote which might deter fungi from developing, as carbolic acid certainly did.

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* [Author's Note.—Since the above was in type I have seen Dr. Delépine, Professor of Comparative Pathology and Bacteriology in the University of Manchester. He tells me that he constantly has diseased stone submitted to him for examination, and frequently finds the cause to be various micro-organisms, which do not all require the same treatment. He showed me at the Public Health Laboratory, of which he is Director, a bundle of such specimens just received from the City Architect, and also cultivations from others in various stages. He mentioned sulphate of copper as one of the most useful applications.]

DR. F. A. BATHER agreed that the decay mentioned could not be due to wind erosion, since the wind could not act without sand or ice particles (snow) to drive against the stone, and in the present case such abrasive particles were not at hand. While the paper was being read, the idea that the decay might be due to some organic agent had independently suggested itself to him, and, while admitting the force of Mr. Sheppard's able criticism, he would remind his hearers that many processes previously believed to be purely physical were almost daily being proved due to the action of bacteria or other humble forms of life, *e.g.*, the nitrate-bacillus of South America and the sulphur-bacillus of the Black Sea. It had been suggested that a peculiar leprosy (as Old Testament writers would have called it) which attacked bronzes was due to bacteria, and perhaps Mr. Reginald Smith could give them some information on that point which would elucidate the present case. If the decay were due to bacteria, sulphate of copper would certainly prove a good disinfecting agent, as shown by its use in the purification of drinking water. It would, however, require renewal, and he would suggest that some hardening fluid, such as Browning's Preservative Solution,* would be more permanently effective.

MR. REGINALD A. SMITH said that the preservation of ancient metal objects had been dealt with by Dr. Friedrich Rathgen, of the Berlin Museum, and members might usefully consult his book upon the subject.† He also mentioned the name of Sir Arthur Church as a recognised authority upon the subject under discussion. He would no doubt be willing to advise Dr. Anderson.

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* See the speaker's paper on the Preparation and Preservation of Fossils, *Mus. Journ.* vol. 8, p. 86.

† "The Preservation of Antiquities." (Translated by G. A. and H. A. Auden, Camb. Univ. Press, 1905.)

MR. H. BOLTON said it seemed to him that the whole question was one of bio-chemistry. Possibly we had to consider a chemical action upon the stone set up by bacteria somewhat similar in their nature to the nitrifying organisms upon which experiments had been carried out so successfully at Rothhampstead (Herts).

THE PRESIDENT said he certainly found that a solution of copper sulphate preserved the stone better than anything else, though the treatment was objected to by some on the ground that the stone was coloured by the solution. He hoped that members of the Association would seriously consider the matter and carefully weigh the points raised by Dr. Bather. He thought that the germ theory advocated in the paper was acceptable on the ground that it was possible for a bacillus to exist in stone. The erosion had been most marked during the past twenty years, and this was a fact worth noting, suggesting as it did that the organism concerned had been at work during a definite period.

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The VOLCANO *of* MATAVANU *in* SAVAII.

By TEMPEST ANDERSON, M.D., D.Sc., F.G.S.

[PLATES XLV-LII.]

THE Samoa or Navigator Islands are a group in the Western Pacific, lying in 13½° to 14° S. lat. and 168° to 173° W. long. They are some 350 miles north of Tonga, and between 400 and 500 miles north-east of Fiji. From Auckland (New Zealand) the sailing distance is 1560 miles, and from San Francisco about 4400.

The group consists of nine islands, in addition to rocks and islets, but only four are of any notable size, namely: Upolu, Savaii, Tutuila, and Manua. The two first-named belong to Germany and the two last-named to the United States. They are mountainous, but at the same time well wooded, and are all, with the exception of Rose Island, volcanic, and for the most part surrounded with coral-reefs. They are disposed in a linear direction from north-west to south-east, and a line drawn from the volcanic region of New Zealand and thence through White Island, Pylstaart, the Kermadecs, and the Tonga Islands, all of which contain volcanoes active or extinct, would pass through the group. It is probable that each of these lines marks a fold-fissure or line of weakness of the earth's crust. It is noteworthy that a volcanic eruption took place in the Tonga Group at the same time as the great eruption of Tarawera in New Zealand, in June 1886.

Savaii is the westernmost and also the largest of the group. It is 48 miles long and at least 25 miles wide, but the interior has never been surveyed. It has a backbone of volcanic mountains, all formed of different varieties of basalt.

One of these, Mauga Loa, rises to a height of 5600 feet. Another, 7 or 8 miles to the west, has the suggestive name of Mauga Afi (mountain of fire), and from it and its parasitic craters most of the extensive lava-streams in the west of the island appear to have proceeded. An eruption which destroyed Aopo, a town in this district, probably took place about 150 or 200 years ago, judging from information given to Mr. Williams[1] by an old man,

---

[1] For most of the information about the commencement and progress of the eruption, and for many other kindnesses, I am indebted to Mr. Richard Williams, Amtmann of Savaii. He allowed me access to his copious manuscript notes and official reports, and furnished me with a copy of a map of his own making, which shows the position of the volcano, and the extent of the lava-flows at various epochs.

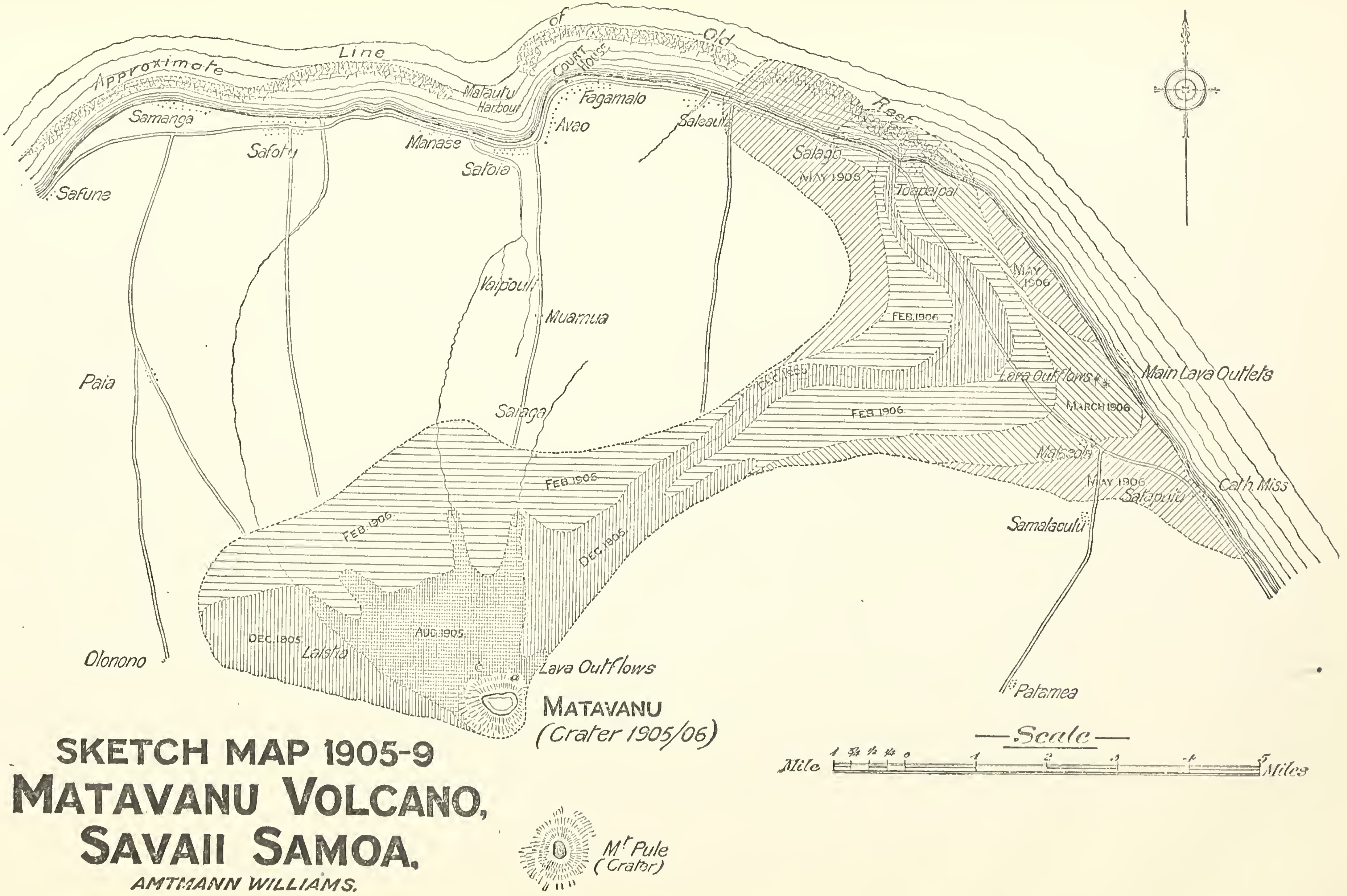
The following papers and articles have also been consulted, but are unfortunately not very accessible to English readers:—

H. I. JENSEN. Proc. Linn. Soc. N.S.W. vol. xxxi (1906) p. 641. This contains an early copy of Mr. Williams's map and some remarkable photographs by Capt. Allen, who in the ordinary course of his voyages regularly passes the volcano. It also contains a description of the petrology of the lavas.

W. VON BÜLOW. 'Vulkanische Tätigkeit auf Savaii' Globus, July 12th, 1906.

R. DEEKEN. 'Neuer Vulkan im Stillen Ozean' Deutsche Kolonial-Zeitung 1906, p. 273.

KARL SAPPER. Zeitschr. f. Erdkunde, Berlin, 1906, p. 686. (A good compilation.)



SKETCH MAP 1905-9
MATAVANU VOLCANO, SAVAII SAMOA.

AMTMANN WILLIAMS.

whose grandfather had talked to him about the event, but could not himself remember it. The lava-fields of this eruption are more extensive and more rugged in character than those of the present eruption, and like them they reach the sea.

From a crater about 2 miles north-east of, and probably parasitic on, the volcano of Mauga Afi, and 4 miles south-south-east of Aopo, a small eruption took place in 1902. An indistinct crater was formed, and also a lava-stream nearly half a mile wide and 2 miles long. The lava is of the scoriaceous or 'aa' type. This eruption was accompanied by severe earthquakes, which was not the case in that of 1905.

More to the east is a large crater with a crater-lake, the name of which, Mauga Lapainé or Pule, is suggestive of Montagne Peléo in Martinique, and Pelé the goddess of the Hawaiian volcanoes. From it most of the flows near Papalaulelei (smooth lava), at the east of the island, have proceeded; while a little to the north of it and at a lower elevation, say 2000 feet above the sea, is the new cone of 1905, from which the eruption of that date took place and still continues.

I understand that, before the eruption, the place where the crater now is was a sort of elevated plain surrounded by mountains. It was almost level, and in fact a favourite camping-place for pig-stickers. It was near the now deserted plantation of Olonono. The name Matavanu is a native one, and was, I understand, first applied to the volcano by Herr von Bülow, a resident in the island and a cousin of the former German Chancellor. From near this place a deep and tortuous valley extended down to the sea, a distance of 10 or 11 miles, though that measured in a direct line to the sea at Matautu is only about 7 miles. The lower part of the valley was very fertile, and along the coast at, and on each side of, its mouth were prosperous villages. This part is now overwhelmed by the lava.

The western portion of the coast in question was protected by coral-reefs, and on it were situated the villages of Saleaula, Salago, and Toapaipai, and this district was called Le Ala Tele. Judging by the coast farther west about Matautu, these villages had been built on a bank chiefly formed of coral-sand raised not many feet above sea-level, and often with a swamp behind them. Farther to the east of Toapaipai came a stretch of iron-bound coast—that is, coast formed of old lava not protected by a coral-reef; a promontory here was called Asuisui, and this is near the point where the lava flows into the sea (1909). Farther east again was another region of coast protected by reef, and on it were situated the villages of Malaeola and Sataputu. A good buggy-road extended the whole way at varying distances from the coast, and led to the villages of Samalaeulu and Patamea, which still exist. There were also in the vicinity of the crater valleys leading in the direction of Safotu, the upper parts of which are now filled up.

The eruption began on August 4th, 1905. At first the ejecta were mostly solid, and the space covered was not large; but from

Saturday September 2nd to September 4th molten lava was poured out, which advanced 2 miles.

On October 28th the lava was at Saleaula, and on November 3rd the lava-stream at Saleaula was a quarter of a mile across, the side of the crater fell out, and a flood of lava issued therefrom.

On December 7th the lava reached the sea at Toapaipai. It filled up the lagoon between the shore and the reef, a space perhaps a quarter of a mile wide and of depth varying from 20 to 30 feet. It then took a turn westwards along the reef, leaving untouched a part of the lagoon which was not filled up until later.

From Sunday, January 28th, 1906, to the middle of February there was great increase of activity; the lava extended along the coast from Salago to Saleaula, a distance of 1130 yards, burnt Mr. Bartley's house, and filled the space between the shore and the reef. On the ironbound coast to the east of this, the lava-flow was about three-quarters of a mile broad, and still farther east half the town of Malaeola was destroyed.

On March 6th, 1906, the lava extended along the coast eastwards to within 200 yards of Sataputu, which village was destroyed somewhat later.

On March 3rd, 1906, the lava ceased running in the swamp behind Saleaula, this being the furthest extension of the lava to the west. Near the coast about half the town of Saleaula had been destroyed, the devastation reaching to about a mile and a half from the Government Offices at Fagamalo in the town of Matautu. Besides filling up the space between the shore and the reef at Saleaula, the lava has extended westwards along the summit of the reef for a considerable distance, and blocks up one of the entrances to the lagoon. The lagoon between the shore and the reef was not filled up until later.

The formation of the coast is little altered where it was previously 'ironbound,' as the lava there flows directly into deep water. Where, however, there was formerly a reef with a lagoon between it and the coast, the lagoon is generally filled up, and the coast-line correspondingly extended as far as the line of the old reef.

In the early part of the eruption the lava did not extend far from the crater, the longest streams not exceeding 2 or 3 miles, and these did not present the same heated appearance as subsequently, but were covered with moving scoriæ and stones, so that the whole mountain appeared to be in motion. Later on the lava was often very abundant and liquid: at times it flowed like a river of water 200 yards wide; at others as numerous small streams not above 10 feet wide, and in these cases was often so fluid that it nearly all ran away and only left a fresh crust less than 2 inches thick, over which it was safe to walk next day.

The large fresh lava-streams soon got crusted over on the surface with solidified lava, and the liquid lava continued to flow underneath. Even at the crater it seldom flowed over the lip, but generally entered holes and tunnels in the sides and flowed underground. The lava-field thus became honeycombed with channels of liquid or pasty lava, which occasionally came to the surface, and flooded it with fresh sheets of lava; at other times, the surface frequently floated up and was raised by the intrusion of fresh lava underneath, so that what had previously been the course of the valley now became the highest part of the field. Mr. Williams thinks that the lava must be in some places 400 feet thick.

In the beginning of September 1906 the lava-flows near the seacoast extended considerably farther eastwards, probably a mile. The mouth of the river was blocked, and the village of Sataputu, including a Catholic Church and Mission House, was overwhelmed. The lagoon, which was in places 30 feet deep, was filled up, the passage into it was blocked, and the coast-line pushed seawards about 300 feet. The total length of sea-front covered at different times by the lava was nearly 9 miles; and, from the westernmost point inland near Olonono to Sataputu the easternmost, not less than 15 miles.

On August 7th, 1908, Mr. Williams noted that the lava continued to run strongly into the sea, having only stopped for one day; it directed its course chiefly towards Le Ala Tele, in the former position of Toapaipai, and the promontory of Asuisui.

‘Tidal’ Waves.

It is interesting to note that several so-called ‘tidal’ waves have occurred during the eruption. The following were noticed at Matautu by Amtmann Williams:—

November 28th, 1906	5.30 P.M.
June 8th, 1907	at noon.
June 19th, 1907	3 A.M.
June 27th, 1907	between 6 & 7 P.M.
July 9th, 1907	6.45 P.M.
July 25th, 1907	11 A.M.

The tide usually rises and falls about 4 feet at Matautu. Most of these waves did not exceed 6 to 8 feet in height, and as many of them occurred at low or half-tide, and there was no heavy sea on at the time, little damage was done, although in several cases the main road of the town was flooded. The largest and most important of the series was that on Sunday, October 6th, 1907, about 5.30 P.M. It was just at the time of high water, but the sea was smooth. The wave was 10 or 12 feet high: it came from the north-east round the lava-point, as in fact the others had done, and at the Deutsche Handels & Plantagen Gesellschaft’s place a boat-house was wrecked, a buggy in it smashed, and several boats were damaged; while, at a house a few score yards off, a 400-gallon tank of water was lifted bodily from its foundation and carried across the road. The wave appears to have spent itself here and, it was thought, probably rebounded out to sea. No damage was done at the Government Offices, 150 yards distant, nor in either direction along the coast.

The wave was noticed, but of smaller size, in some of the other islands. At Apia it had a height of only 1 or 2 feet. It was probably connected with the lava falling into the sea, but the exact cause was uncertain. Possibly it was due to a steam-explosion.

Present State of the Cone and Lava-Fields.

From the sea at night the view of the volcano is extremely striking.[1] The glare from the incandescent lava in the crater reflected on the clouds is visible for a distance of 50 miles or more, while on nearer approach the spectacle of a number of streams of red-hot lava descending into the sea and raising columns of illuminated vapour is very remarkable and at present probably unique. By day the view, though quite different, is equally interesting. The crater rising to a height of 2000 feet with a backing of hills, or rather mountains of double that height, and with several old cones of different ages dotted around, is surmounted by a magnificent canopy of white steam of the well-known pine-tree shape, often breaking out into the equally well-known cauliflower lobes. This frequently rises to a height of 8000 or 10,000 feet (Pl. XLV, fig. 1). Surrounding the crater for a distance of a mile or two in the shortest direction, and stretching down to the coast in the sinuous line indicated on Mr. Williams's map, are the great black lava-fields, which comprise an area of probably at least 20 square miles. At intervals along these lava-fields, and taking an equally if not more sinuous line, are several conspicuous clouds of vapour escaping from as many fumaroles, some of large size, which mark the line of a great lava-tunnel to the sea-shore, and there are some smaller ones in the other direction more to the west, which show the position of a smaller underground stream towards Safune. In the foreground again is the new coast-line formed of the widespread fresh lava-currents, with usually several magnificent columns of vapour rising some hundreds, or even thousands, of feet into the air from the places where the lava is for the moment falling into the sea. With a very good glass the observer may perhaps distinguish the towers or other parts of two churches, which are nearly all that mark the position of the destroyed villages of Saleaula and Sataputu; while a still more careful scrutiny will enable him to make out a few dead tree-trunks still erect among the lava and many more lying prostrate on its surface. Looking still farther afield are large areas where whitened tree-trunks are all that remain of the once dense tropical jungle, though in some places vegetation is beginning to return. Such is the view, some details of which call for a fuller notice.

The cone does not rise high above the surrounding lava-field. At the east side there is one point where the slope of the latter continues uninterrupted to within about 50 feet vertical of the lowest point of the lip of the crater, and even then the slope up to it is still very gradual, and probably does not exceed 15°. At other points the edge of the crater is somewhat more elevated,[2] and may reach an altitude 150 feet higher than the point referred to; and, as the lava-fields are in places lower, it is probable that there are points where the cone rises to a height of 350 feet above them.[1] The outside slope is in most places gradual; I did not notice any place where it appeared to exceed 33° (Pl. XLV, fig. 2). The crater itself is oval, and apparently about 400 by 200 yards in area; its long axis runs approximately south-west and north-east. Its inner walls are very steep throughout, and in many places precipitous and even overhanging. They are composed of the usual beds of lava and fragmentary material; but, except in the southern wall, where tuffs are abundant, the lavas predominate much more than in some other volcanoes that I have seen (Pl. XLVI). When on the spot, I estimated the depth down to the lava-lake to be mentioned presently at about 400 feet, possibly somewhat less; but, on subsequent comparison with Kilauea, I do not think that it exceeds 300 feet. At about half the depth is a well-defined bench on the walls showing a former height of lava.[2] The strata below this level are much obscured by this dense lava formation; there is also a less marked bench at a still higher level, say about a third of the depth from the lip (Pl. XLVII).

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[1] At night I saw it once from the deck of a steamer of the Union Company of New Zealand, once from a German man of war, twice from a schooner, and also in the daytime from a boat.

[2] My aneroid reading made the height almost exactly 2000 feet.

The bottom of the crater is of an oval form, proportionately narrower than the higher part, in fact with nearly parallel sides. I roughly estimate its length at 300 yards, and its breadth at 75 to 100. It is entirely occupied by a lake of liquid lava all in rapid motion from south-west to north-east, and of such extreme fluidity, that it continually beats in surging waves against the walls, where splashes retain their heat and brilliant colour for some time. The surface is in a constant state of ebullition, though not always to the same degree in different parts. Some of the boilings rise in veritable fountains of incandescent liquid basalt of 10, 20, or even, I think, possibly at times 50 feet high. The whole mass of the lava is at a brilliant white heat, visible as such even in bright sunlight, but a darker scum is continually forming on the surface, especially when the trade-wind blows strongly on it. These pieces of scum, like ice-floes, break up and flow down to the north-eastern end of the crater, where they and the liquid lava disappear down a hole, or rather tunnel, at the foot of the cliff. The tunnel is perhaps 30 feet wide. Its roof is quite low, and is nearly touched by the surface of the lava, which rushes under it at a steep slope with the velocity of a cataract. There is also another smaller hole at the foot of a cliff forming the north-western wall of the crater, down which a stream of lava seems constantly to flow; but this is small in comparison with the other. The wall forming the north-eastern end of the crater above the outflow of the lava is of a structure different from that forming the adjacent parts on each side, and seems to be a great chasm filled in with fragmentary material of a later date, and possibly partly with lava frozen on to the roof of the conduit.[3]

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[1] See H. I. Jensen, Proc. Linn. Soc. N.S.W. vol. xxxi (1906) p. 653.

[2] This may have been the height of the lava in 1906, as mentioned by Jensen, *op. cit.* p. 653.

[3] I saw this clearly in the evening and night on two distinct visits; but, when I returned to photograph it by daylight, that part of the crater was so obscured by vapour that it was impossible to bring out the details. The chasm may have been formed when the side of the crater fell out on Nov. 3rd, 1905.

At the south-western end of the crater is also a tunnel larger and higher than that by which the lava escapes on the north-east. Its interior is incandescent, and its floor occupied by liquid lava. I am not at all sure that any lava goes out or comes in through it.[1] The whole bottom of the crater is, in fact, in such a turmoil, the lava boiling and surging up first in one place, then in another, that it is impossible to say definitely where the exact point of entrance is. On the whole, I am inclined to think that it is mainly towards the south-western end, in front of the entrance to the south-western tunnel. It is not unlikely that a fissure extends for the whole or greater part of the length of the bottom of the crater, and possibly for some unknown distance beyond each end of it.

The surface of the cone is mostly composed of a series of flows of basaltic lava, similar in type to that which forms the fields around. A considerable number of bombs or ejected blocks of lava of similar character are scattered over the surface; but beyond this the evidences of explosive action, at any rate in the later stages, are very few. In the earlier stages the action appears to have been more of the explosive type (Pl. XLV, fig. 2).

The lava-fields are extensive and irregular in shape, as may be seen from the accompanying map (p. 622). They comprise a considerable area round the cone, being most limited on its southern and eastern sides, where their further extension was prevented by the hills. They are somewhat more extensive towards the west and north in the direction of Safune and Safotu, where they have filled up the upper parts of several valleys. This part of the field shows a few fumaroles, and apparently receives the lava which enters the small north-western tunnel from the crater. The most extensive area, however, is towards the north-east in the direction of the sea. It is at first confined between hills, and becomes narrowed and sinuous in consequence, and lower down spreads out into the broad expanse near the coast. The molten lava which enters the tunnel at the north-eastern end of the crater flows under this part of the field. The surface is very rough and irregular, and presents large areas both of scoriaceous or cindery lava (locally called 'aa'), and slaggy, ropy, or corded lava (locally 'pahoehoe'). Of the latter variety there are large areas as regular as anything in Iceland, where the Odadhraun presents hundreds of square miles of such beds; or, again, like the less regular corded and festooned lavas on Vesuvius before they were covered up by the recent eruption; and there are fields composed of blocks of the surface-crust of such varieties broken up by subsequent movement, and forming some of the most difficult ground to traverse which it is possible to conceive (Pl. XLVIII, figs. 1 & 2).

One of the chief characteristics of these fields has been the great fluidity of the lavas at the time when they were poured out.

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[1] I have seen caves and tunnels in Halemaumau, the 'working pit' of the crater of Kilauea, where the wall was being dissolved and undermined by convection currents of hot lava. They presented appearances quite comparable with this and the small lateral tunnel above mentioned.

Places are common where the surface is covered with fresh sheets of lava measuring an inch or even less in thickness; and the surface is honeycombed with channels along which the lava has flowed, channels which are occasionally deep and open, but often have a crust, sometimes thick, sometimes so thin as to give way under a man's weight, and form dangerous pitfalls for the unwary. There are, too, caves and bubbles of all sizes up to many feet in diameter, often also covered with only a thin roof equally liable to collapse (Pl. XLIX, fig. 1), and many areas, sometimes extensive, where the liquid lava beneath has found a vent lower down after a crust has formed on the surface, and the whole crust has subsided after the manner of the plain of Thingvalla. Tunnels can be seen by which the lava has escaped.[1]

This class of subsidence by lava flowing out from under a crust seemed to me common on the lower parts of the lava as well as on the upper, and there are two notable examples at the eastern foot of the cone (Pl. XLV, fig. 2). The lava-tunnels and evidences of rapid flow, superficial and deep, are numerous along the line of great fumaroles. On my ascent of the cone I had occasion to cross the line three times, in order to find a practicable route. From the causes named above, the surface, especially in the upper part, was so rotten that progress was extremely difficult; while the certainty that the river of molten lava was running somewhere below at an uncertain depth and under a crust of unknown thickness, combined with the approach of night, rendered delay undesirable. I was, therefore, unable to examine the fumaroles carefully[2]; but, so far as I could see, one of them was a large hollow with precipitous sides, apparently of the nature of a subsidence from the collapse of a crust of lava by combined remelting and withdrawal of fluid support below; and subsequent examination of similar places near Kilauea has confirmed this opinion. At Matavanu few of them appear to have been examined, and in still fewer was the liquid lava visible, but I understood that in one it had been seen flowing at a depth of 30 to 40 feet.[3]

The slope of these lava-fields is very gradual. The distance of the crater from the sea is about 7 miles as the crow flies; but, following the sinuosities of the underground current, it may be estimated as somewhat over 10 miles. If the foot of the cone be taken at a height of 1800 feet, this gives an average fall of one in 30, or about 6°, a slope which is of the same order of magnitude as that of many of the Icelandic streams. The slopes of some of the Hawaiian volcanoes formed of the same class of lava are stated by

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[1] Compare T. Anderson 'Volcanic Studies' 1902, pls. lviii–lviii A & lxxii.

[2] The next day the wind blew the fumes against us, and prevented further examination.

[3] I have since received from Mr. Barts of Fagamalo a photograph of one such 'pit crater,' showing precipitous walls composed of very numerous thin layers of lava, presumably both surface-flows and intrusive sheets, comparable to those in the wall of the crater; also another photograph showing a pit with its walls coated with lava frozen on to them, somewhat like the wall of the crater shown in Pl. XLVII. This pit appears to have been an orifice by which lava rose and flooded the surrounding lava-field.

Dana [1] to be even less, sometimes not even more than 1°, an observation which I can personally confirm, in the case of the lavas of Kilauea. It is to be remarked that at Matavanu the lava-stream is highest in the centre over the line of the tunnel, and tends to become more so owing to frequent small flows of lava which, whenever the flow beneath is obstructed from any cause, rise to the surface and then spread out and solidify there. This class of flow is more common as the sea is approached, so that the surface nearer the sea is often higher than that inland, and the direction of the flows in the lower part is thus often away from the sea, and in the reverse direction to that of the flow underneath by which they are supplied. That the surface of the lava over the tunnels is higher than elsewhere is a matter of observation, and that the difference tends to increase is vouched for by careful observers like Mr. Williams and Capt. Allen. They think that this increase of height is also largely due to lava intruding from the tunnel into the surrounding lava and forming sills and dykes; and, although this is mainly a matter of inference, I see no reason to question its accuracy. On my first attempt to cross the lava and visit the outflow into the sea, our way was stopped by a fairly large flow of lava only a day or two old. It had originated in an opening of the lava-crust near the sea, and spread out inland as mentioned above. My men tried to cross it, and pronounced it impracticable; a dog tried it, and retreated howling. I found a hummock of cool lava near it, on which I established myself and took photographs of the steam-explosions and the intervening lava (Pl. L, fig. 2). This led me to notice particularly a crack in the hummock where the surface had risen apparently by the lateral compression of the surface-crust. When I made another attempt two days later, I succeeded in getting to the same spot, but a new lava-flow had covered a great part of the previous one and advanced even nearer the hummock. I noticed that the surface on which the new flow rested was pressed down and lowered for a distance of some feet in front of its edge; while the hummock itself was pressed up, and the crack materially widened. This shows that the lava below the surface was still plastic and capable of being squeezed into new positions, and the acuteness of the deformation or bending of the crust showed its small thickness. It is clear that a considerable amount of intrusive action might take place in such a mass, without leaving much subsequently recognizable alteration. On the lower part of the lava-fields there are also several considerable mounds (or perhaps they might even be called plateaux) formed of large angular blocks of broken compact lava. The mounds were flat-topped, and the blocks presented no trace of igneous action since they had been broken. I could not at the time think of any satisfactory explanation of their formation, but now believe that they have been probably formed by intrusion of lava under the previously consolidated crust, which was broken into pieces as it was pushed up (Pl. XLVIII, fig. 2).

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[1] J. D. Dana, 'Characteristics of Volcanoes' 1890, p. 148.

The Outflow of Lava into the Sea.

This is one of the most striking features of the eruption, and it seems to have been going on, with the exception of one day, since 1905; but, like the flow of lava-streams elsewhere, it is never the same for many hours together.

The lava, on descending to the low ground, has spread itself like a fan, and by successive flows has covered the coast at different times for a distance of 9 miles, destroying four villages (Salago, Toapaipai, Malaeola, Sataputu), and the buggy-road between them, also the whole of the town of Saleaula except two houses. This part of the coast was collectively known as Le Ala Tele, and about half of it, reaching from Saleaula to Toapaipai, was encircled by a coral-reef. The lava has filled up the whole of the space inside this reef. Capt. Allen is quite clear that the lava first filled up part of the space between the shore and the reef,[1] and, on reaching the outer edge of the latter, did not continue to extend into deep water, but turned to the westward along the reef and continued to extend along it for some distance. The space between the shore and this part of the reef was not filled up until later. He agrees with me, however, that much of the reef farther west, which is now strewn with lava-blocks, has been so covered by the action of the waves and currents, and that the blocks are not *in situ.* He thinks that the reason why the lava spread along the reef rather than into deep water was that the lava-front exposed to the open sea was much more rapidly and effectually cooled than that which flowed only to the shallow water on the reef; this, I agree, is the probable explanation.

Having twice tried from the land to examine the place where the lava fell into the sea, and having been each time stopped by hot lava-flows, I determined to examine the coast from a boat. The reef was covered with breakers and consequently inaccessible. Its surface is certainly strewn with large basalt boulders, but, for some distance at the western end at any rate, these appear to be water-borne from the lava coast adjacent. Rowing farther eastwards, we came to the lava *in situ* forming a wave-washed, iron-bound coast of cliffs, 20 to 30 feet high and higher yet farther on. Though at sea the wind was slight and the surface smooth, the heavy low swell of the Pacific was breaking with tremendous force on the shore, the spray dashed nearly to the top of the cliffs, and a very steep beach of basalt-boulders at their foot was obviously undergoing rapid denudation. The cliff consisted of numerous irregularly bedded sheets of massive lava a few feet thick, with thin bands of the usual scoriæ and ash separating them at their joints. One or two small natural arches presented no special features, beyond showing the rapidity of the erosion. On coming nearer the point of entrance of the lava into the sea near the headland of Asuisui, the cliff rises to a height of 40 or 50 feet or more; while, close to the spot where the explosions occur, and especially to the west or leeward of the point, are beds of black sand capping the lava. This appears to be wind-borne and the product of the explosions. The streams vary much from day to day, and even from hour to hour. When I saw them for the first time at night from the steamship *Atua*, there were twelve visible by their own light; a second time, seen from a native schooner, they were fewer and quite different. On a third occasion, when I got as near as possible in a boat, the lava was flowing in four large and distinct streams, and more would probably have been visible at night (Pl. L, fig. 1). I was anxious to observe the formation of pillow-lava and we got as near as possible without melting the pitch-caulking of the boat. Where the discharges were most active explosions were almost continuous, and the whole was obscured by clouds of steam from which fragments of red-hot lava and showers of black sand were seen to fall (Pl. LI). Where the lava was flowing in smaller quantity explosions were much less noticeable, and the lava extended itself into buds or lobes. The process was as follows: an ovoid mass of lava, still in communication with its source of supply and having its surface, though still red-hot, reduced to a pasty condition by cooling, would be seen to swell, or crack, into a sort of bud with a narrow neck like a prickly pear on a cactus, and this would rapidly increase in heat, mobility, and size, till it either became a lobe as large as a sack or pillow, like the others, or perhaps stopped short at the size of an Indian club or large Florence flask. Sometimes the neck supplying a new lobe would be several feet long and as thick as a man's arm, before it expanded into a full-sized lobe; more commonly it would be shorter, so that the freshly-formed lobes were heaped together. They looked white-hot even in daylight, and, as the waves washed over them, the water seemed to fall off unaltered without boiling, owing probably to its being in the spheroidal condition.[1] I have watched the formation of ordinary corded lava on Vesuvius by a similar process of budding. When the hot lava of the interior has got vent and formed a pool, a soft scum forms on the surface, which is pushed forward by the fluid lava moving beneath, and is raised into a wrinkle or cord, then others are formed in the same way, until the surface is entirely solidified into a succession of cords (Pl. XLVIII, fig. 1). The same sort of process can often be watched on the surface of a slowly moving river when rubbish floating on the surface is stopped behind a log of wood. Here it was different: there was no trace of the formation of wrinkles and cords. The whole surface seemed to be chilled at once, as the waves rolled on and off, and examination of cooled specimens between high and low water-mark at the edge of the lava in the lagoon confirmed this. The surface at and below the water-level was roughly granular, like that of air-chilled bombs such as I have seen on Stromboli and Haleakalá, while higher up the ordinary corded or pahoehoe structure was seen (Pl. LII). I was vividly reminded of a section that I have seen at Aci Castello in Sicily.

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[1] See his photographs of this in H. I. Jensen's paper, Proc. Linn. Soc. N.S.W. vol. xxxi (1906) pls. lv–lvii.

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[1] The structure thus produced is analogous to that to which the term pillow-structure, originally applied to a peculiar and exceptional form of spheroidal jointing, has of late years been often extended.

It is very satisfactory to me to find that the mode of formation that I have observed is in accord with the views previously expressed as probable on other considerations by such careful observers as (in chronological order):—

Cole, G. A. J., & Gregory, J. W. 'Variolitic Rocks of Mont Genèvre' Quart. Journ. Geol. Soc. vol. xlvi (1890) p. 311 (and *in litt.*).

Teall, J. J. H. Trans. Roy. Geol. Soc. Cornwall, vol. xi (1893–95) pp. 562–64 & pl. facing p. 565. Also along with Dr. B. N. Peach & D. J. Horne. 'The Silurian Rocks of Scotland' Mem. Geol. Surv. 1899, pp. 84, 431, etc. & pls. iv, vi.

Geikie, Sir Archibald. 'Ancient Volcanoes of Great Britain' vol. i (1897) pp. 25 & 193.

Foreign authorities on pillow-lava are:—

Dana, J. D. Amer. Journ. Sci. ser. 3, vol. xxxiv (1887) p. 362; and 'Characteristics of Volcanoes' New York, 1890, pp. 9, 241, & 243.

Platania, G., in Dr. Johnston-Lavis's 'South Italian Volcanoes' 1891, pp. 41–42 & pl. xii.

Daly, R. A. 'Variolitic Pillow-Lava from Newfoundland' Amer. Geologist, vol. xxxii (1903) pp. 74–78, with a discussion and references.

Before the eruption a small river came down from the mountains, passed through the villages of Patamea and Samalaeulu, and fell into the sea at Sataputu. Both the higher and the lower reaches of the river have been covered over and filled up with lava, leaving the channel at Patamea and Samalaeulu unobstructed, but usually empty. The rain, which falls on the former gathering-ground, is soaked up by the lava and possibly percolates elsewhere, so that scarcely any water now comes down the channel except in very heavy rain-storms, which have only occurred once or twice since the eruption. On one such occasion the water could not get away owing to the obstruction near the old mouth, and the country round was flooded. The empty channel is a good example of a water-eroded gorge cut in geologically recent beds of lava, and shows the usual water-holes, as also small falls in its bed. At one place where I saw it, it was nearly 30 feet deep and not much wider. At others it was perhaps 3 or 4 times as wide.

The Destruction of Buildings.

The native houses in the villages destroyed consisted merely of thatched roofs supported on wooden poles. The churches of Saleaula and Sataputu were, however, substantial stone buildings

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Clements, J. M., Monogr. U.S. Geol. Surv. xxxvi (1899) p. 124, thinks that pilow-lava is a form of aa, not pahoehoe. The aa referred to is not the common scoriaceous form, but one described by Dana as above.

Having now seen the actual formation of all three—aa, pahoehoe, and pillow-lava, I am satisfied that the scoriaceous form of aa is produced by watery vapour expanding from inside the pores of the lava; pahoehoe from the slow cooling of lava containing little vapour; and pillow-lava (at any rate one form) from the chilling action of water on the surface before it has time to assume the corded structure of pahoehoe. I have not seen the formation of aa as described by Dana.

as was also a house near Saleaula belonging to Mr. Bartley. In these three cases, although the interiors were burnt and gutted, the lava was fluid enough to surround the structures and bury them in various degrees without overthrowing the walls. Thus the body of the church of Sataputu was entirely buried under 30 or 40 feet of lava, and the only part remaining visible is the tower which still rears its head above the lava-field (Pl. XLIX, fig. 2). The walls were, in this case, substantial enough to cool the lava where it touches them, and so far to solidify it that subsequent flows were kept back, the upper part remaining uncovered in the middle of a depression which almost simulates a subsidence.

Mr. Bartley's house, though gutted, remains standing in the midst of a similar depression. The lava in this case was not so deep as in the first.

The church of Saleaula was near the edge of the lava, which was consequently of no great thickness; the lava was fluid enough to enter the building through the windows and cover the floor to a depth of several feet, without overthrowing the walls.

Damage to Vegetation.

All vegetation overwhelmed by the lava was, of course, killed; but much more damage was done by the Ua Sami, or poisonous gases, discharged from the crater, or formed by the action of the hot lava on the sea-water. The destruction of vegetation was naturally greater in the vicinity of the crater, and was especially severe on the high ground to the west, owing to the prevailing wind being easterly and north-easterly. On the descent from the crater in this direction the destruction of trees was complete, and to nearly as far as Olonono, a distance of 2½ miles, their bleached skeletons were all that remained. It was only in a few sheltered situations that the low undergrowth was beginning to return from the old roots, till this distance was reached, the trees having suffered more than the undergrowth. I heard from credible sources that the cocoa-nut palms had been killed as far as 5 miles to the west of the crater. On the low ground, both at Saleaula on the west, and Sataputu on the east, the damage was less. Trees close to and actually in the lava were killed, and I noticed many moulds where the lava had solidified round them, and the trunks had subsequently decayed[1] or been burnt out; but luxuriant tropical growth had returned right up to the lava, and was beginning to spread over it, especially near Sataputu. The plants that seem to be the pioneers were especially the creeping vines like *Ipomea*; and it is noticed that these were similar to, if not identical with, some of the commonest pioneer plants on the Soufrière of St. Vincent.

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[1] In Hawaii I have seen this process carried a stage further. The lava has cooled and solidified so as to form a mould round a tree, but this solidification has only extended to a distance of a foot or two, the surrounding lava still remaining fluid. The flow has continued its course, and the still fluid part run away, so that a tube of solidified lava like a chimney 10 or 12 feet high remains standing and marks the position of the former tree.

At Matautu, 2 miles west of the lava, the damage was due to the Ua Sami formed by the action of the lava on the sea-water, which was considered even more poisonous than that discharged from the crater. Many cocoa-nut palms had been damaged and some had died, but most had recovered; while several breadfruit trees were killed entirely, and some recovered only with the loss of their upper branches.[1]

During the night of my visit to the crater some large frigate-birds of two kinds, black and white, with long tails, were constantly circling about the crater at a height of several hundred feet, and were clearly visible in the lurid reflected light. They have been noticed by others to whom I have spoken.

Mr. H. I. Jensen (*op. cit.* pp. 666–70) gives a full account of the petrology of the Samoan lavas: I quote only his conclusions. Petrologically the Samoan rocks are very like one another and the basalt near Auckland (New Zealand). The olivine content varies from *nil* to nearly 50 per cent. Most of the rocks are hypohyaline, if obtained from a depth beneath the surface of a flow; hyaline or hemicrystalline, highly vesicular or scoriaceous, when obtained near the surface. The earlier rocks erupted were probably augite-andesites, the later rocks being olivine-basalts. The new flow is richer in iron-ores than any of the old flows. Mr. Jensen does not discuss the reason of the high temperature and great fluidity of the lava at the moment of the eruption.

Comparison with Kilauea.

It may be well to discuss the many resemblances and few differences between the volcanoes of Matavanu and Kilauea in Hawaii, which latter I visited soon after the former. Both are of the effusive type, that is, characterized by the discharge of lava very slightly charged with steam and other volcanic gases, and hence little subject to explosive action: in which respect they contrast strongly with the volcanoes of the West Indies and Central America, where most of the recent eruptions have been highly explosive, and attended with the discharge of a vast quantity of ashes, lapilli, and pumice, but little or no lava. Not that explosions have been entirely absent in these Pacific volcanoes: I found in the walls of the crater of Matavanu some beds of tuff, that is, consolidated ash, but they were subordinate in thickness and importance to those of lava; and also on the flanks of the cone some bombs of basalt. Similarly on Kilauea I saw a bed of lapilli about a foot thick, but it was on the slopes of the old encircling cone comparable to Monte Somma, and there was no trace of such about the working crater. Moreover, its amount was strikingly different from the deposits of ash ranging up to 100 or 200 feet in thickness formed in 1902 on the Soufrière in St. Vincent, or on Montagne Pelée in Martinique, or on Santa Maria in Guatemala, or even those formed on Vesuvius in 1906.

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[1] No human lives were lost by the eruption.

Then, again, there is the high temperature of the lavas and their power of remelting, dissolving, and carrying away previously solidified lava, and even surrounding rocks. At Kilauea this has been described by various observers, and I myself saw the incandescent molten lava in the 'working pit' eating into the walls and forming caves. Two of these, during my stay, undermined considerable portions of the so-called 'black ledge,' that is the most recently solidified portions of the lava-lake. The roofs of these fell in and formed recesses scores of yards across, which really deserved the name of bays. Prof. Daly, of the proposed observatory, told me that there was a cave in the walls of the working crater above the black ledge and pit evidently formed in the same way, and I saw landslides which by all analogy had been due to the undermining of the foot of the walls and their consequent subsidence. The vertical or overhanging walls of this crater had apparently been left standing in this manner. The exposed ends of the beds of lava were quite sharp except in places low down, where they showed signs of remelting, and there was no trace of ejected material round the lip of the crater. The same reasoning would apply to the landslides on the walls of the large encircling crater near the Volcano House, and even, I think, to the curious pit-craters (so called) in the neighbourhood, such as Kilauea Iki and several others.

Matavanu supplies abundant evidence of the same action. It is true that there is no old encircling crater with its landslides and subsidences; but the working crater has walls in many parts vertical or overhanging, and cracks about the lip showed that portions were ready to fall in, and rendered caution necessary in approaching the edge. The strata in the walls in the upper parts, where not obscured by recent lava-splashes, were broken off sharply like those in Kilauea. Caves and tunnels were visible in the walls, and especially the great tunnel at the western end appeared to be strictly comparable to the caves in the black ledge of Kilauea, and not a tunnel of outflow like that at the other end of the crater. Frozen ledges on the wall indicated former ledges of lava like the black ledge in Kilauea, and showed that the molten river was now flowing out at a lower level than during an earlier phase of the eruption. The mouth of the tunnel into which the lava flows on leaving the crater appears to have undergone a corresponding lowering. The crater-wall above it is much less regularly stratified than the adjacent parts, and appears to consist of agglomerate, or perhaps partly of material frozen on from below. I saw this process going on in one of the caves of Kilauea, where stalactites were forming from the roof. This may be the place from which the great outburst of lava took place in February 1906 (see map, p. 622).

This brings us to one of the most curious apparent differences, but perhaps real resemblances, between the two volcanoes. The lava in Kilauea, as is well known, is in constant motion; and, at first sight, it looks as if it were flowing out at one end of the crater. This appearance is certainly deceptive: the direction of the flow and level of the lava vary frequently; and the places where the lava appeared to flow out a few days previously can then be seen to be solid, and the caves into which it seemed to flow to have solid ends. The motion must be due at any rate to convection currents like those in a boiling pot or kettle, but it is still a question whether this is all.

The movement in Matavanu looks similar but much more active, the waves of liquid basalt are much larger, the splashes remain longer visible when they strike the walls, and the fountains are much larger and generally more active. The molten lava also can be seen to pour like a cataract into the tunnel, and visibly falls into the sea at the other end. Matavanu is therefore certainly a river. Kilauea may be a river, but is more probably a boiling pot. Does the lava of Kilauea at the times when the lake empties itself periodically, say once in five years, also discharge itself into the sea? This has been often supposed, but absolute proof has been wanting. The analogy of Matavanu now supports this hypothesis; and the appearances which I saw, along with Governor Frear of Hawaii, in some enormous cracks and subsidences between Kilauea and the sea give support to the idea.[1]

In conclusion, I wish to tender my thanks to Dr. Solf, Governor of German Samoa, for countenance and introductions; to Vice-Admiral von Cœrper of the Imperial German Navy, and to the Captain and Officers of S.M.S. *Leipzig*, especially Capt.-Lieut. von Luck and Ober-Lieut. von Sastrow for hospitable conveyance on their warship; and above all to Mr. Richard Williams, Amtmann of Savaii, whom I have so often quoted above, for much hospitality and practical assistance. Thanks are also due to Messrs. Ludwig Schrœder of Safune and Herbert Edwin Rae of Apia and to Serjeant Suisala (himself a native chief) for practical assistance of various kinds.

EXPLANATION OF PLATES XLV–LII.

Plate XLV.

Fig. 1. Matavanu from the sea.—A background of old volcanic mountains; then the new cone of Matavanu, surmounted and partly concealed by a cumulus and a lower stratum of condensed vapour. In front of this are seen the lava-fields covered with a little fleecy vapour, and themselves partly surrounding two old cones. Still nearer is the tropical jungle, and then the sea.

2. Matavanu: the cone and upper lava-field seen from the south.—In the distance is the cone. The lip of the crater extends from a point near the right of the plate to nearly the same distance from the left edge. The field in front is formed of slaggy lava (pahoehoe), and appears to have stood originally at a higher level, up to the ridge at the foot of the cone. After the formation of a crust, the lava beneath it has found a vent and the surface has subsided considerably, especially to the right and centre of the foreground.

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[1] A discussion of these subsidences would, however, be premature until all the photographs are developed and can be examined.

Plate XLVI.

The southern wall of the crater.—On this side of the crater tuffs predominate over bedded lavas. Below the cloud of vapours on the right, and just outside the picture, is the tunnel mentioned as probably caused by remelting.

Plate XLVII.

The western end of the crater, from the same point of view as Pl. XLVI. (To the left the picture should join the last.)—On the right the lower part of the wall is covered with layers of lava which have frozen on to it. The western tunnel is almost concealed at the bottom of the column of vapour. On the right of this column (near the centre of the plate) is a rock which appears to be a dyke.

Plate XLVIII.

Fig. 1. Part of a lava-field.—A characteristic patch of slaggy lava (pahoehoe) showing the corded structure. Much of the scoriaceous lava (aa) is similar to that of Vesuvius or Etna. See T. Anderson, 'Volcanic Studies' 1902, pls. vii, viii, & xviii.

2. Lava-field with broken-up blocks, near the site of Toapaipai.—The greater part of the field is slaggy lava of the ordinary type. In the foreground, near the figure, the crust has been broken up by addition to or subtraction from the volume of the imperfectly consolidated lava beneath. In the middle distance on the right is a large bank of similar but bigger blocks, apparently due to the same cause. Farther away, at the foot of the hills, is the row of great fumaroles which mark the underground course of the lava on its way to the sea.

Plate XLIX.

Fig. 1. Lava with subsidences and a tunnel, near the site of Sataputu.—This is slaggy lava of the usual type. After the freezing of a crust the still liquid lava has found a vent and flowed elsewhere, leaving a cave or tunnel below. Towards the left end of the nearer subsidence are two small ledges, marking halting-places of the liquid lava during its fall. On the surface are dead trunks of trees and in the distance are trees, some killed outright, some recovering. The greater part of the country now buried under this lava-field was previously covered with similar forest.

2. The tower of the church of Sataputu.—This is all that remains to mark the site of that once flourishing village, which is now buried under about 30 feet of lava. It is chiefly remarkable for the depression round the tower, which simulates a subsidence; but the lava shows no marks of having been higher than it is at present.

Plate L.

Fig. 1. The lava flowing into the sea.—This photograph shows a place where the lava is flowing quietly into the sea, and producing a structure which appears to be a form of pillow-lava, as described on p. 632. The sea was boiling, and we did not approach nearer, for fear of melting the pitch-caulking of the boat.

2. Steam-cloud at Asuisui.—A view taken from the surface of the new lava. The foreground is corded lava of the usual type, and some of it had probably only been erupted the previous day. It was too hot to walk upon. The lava is falling into the sea just on the farther side of the ridge.

PLATE LI.

An explosion as the lava falls into the sea.—This photograph, for permission to reproduce which I have to thank Capt. Allen, was taken by him from the cooled and solidified surface of the lava, near the spot where the still liquid mass from beneath was running into the sea, not far from the site of Toapaipai. Masses of red hot lava are seen in the air, each leaving a track of steam behind it. I saw many such explosions through the binocular, but did not get near enough to obtain a photograph equal to this.

PLATE LII.

Lava in the lagoon, near Saleaula.—The lava in the background above high-water mark has cooled slowly, and had time to assume the usual corded structure. In the foreground, between tide-limits, many of the lobes have flowed into the water and been chilled before they had time to do this. They present a structure resembling one variety of pillow-lava.

[NOTE.—The dates of the various lava-flows stated on p. 624 were taken in 1909 from Amtmann Williams's notes. The map on p. 622, with his latest corrections, was not received until the text was in type. The few small discrepancies will not, it is hoped, materially affect the general narrative.]

DISCUSSION.

Sir ARCHIBALD GEIKIE commented on the interesting character of the discourse to which they had listened, and on the instructive pictures which, as shown on the screen, had brought the details of a little-known volcanic region so vividly before their eyes. The type of volcanic action described by the Author belonged to that which had long been familiar as displayed by the Hawaiian volcanoes, but a special value attached to his observations on the end of the lava-stream where it enters the sea. The speaker believed that never before had the phenomena there presented been so closely watched and so instructively photographed. The Author deserved infinite credit for the courage and persistence which, in spite of a trying temporary lameness, had overcome all the natural difficulties of the place, and had enabled him to bring home so large an amount of material for the elucidation of various problems in the mechanism of volcanoes.

Mr. H. H. THOMAS, referring to the motion of fluid lava beneath a solid crust, mentioned an area of 200 square miles of lava in Central Iceland, which was covered with subsidiary vents or spiracles rising to heights of 10 or 15 feet above the average surface.

The PRESIDENT (Prof. WATTS) said that he was much impressed by the Author's description of the origin of pillow-lava. It had long been thought that this structure was the result of basic lava pouring into the sea, but this appeared to be the first case in which the actual production of it had been observed and described.

The AUTHOR, in reply, said that the spiracles mentioned by Mr. Thomas were very abundant in the Myvatn district of Iceland, and were generally, and he believed correctly, attributed to the hot lava flowing over mud or similar wet material. The steam generated made its way up through the lava, escaped through cracks in the crust, and blew out masses of pasty lava which fell round the orifice and built up the cones referred to.

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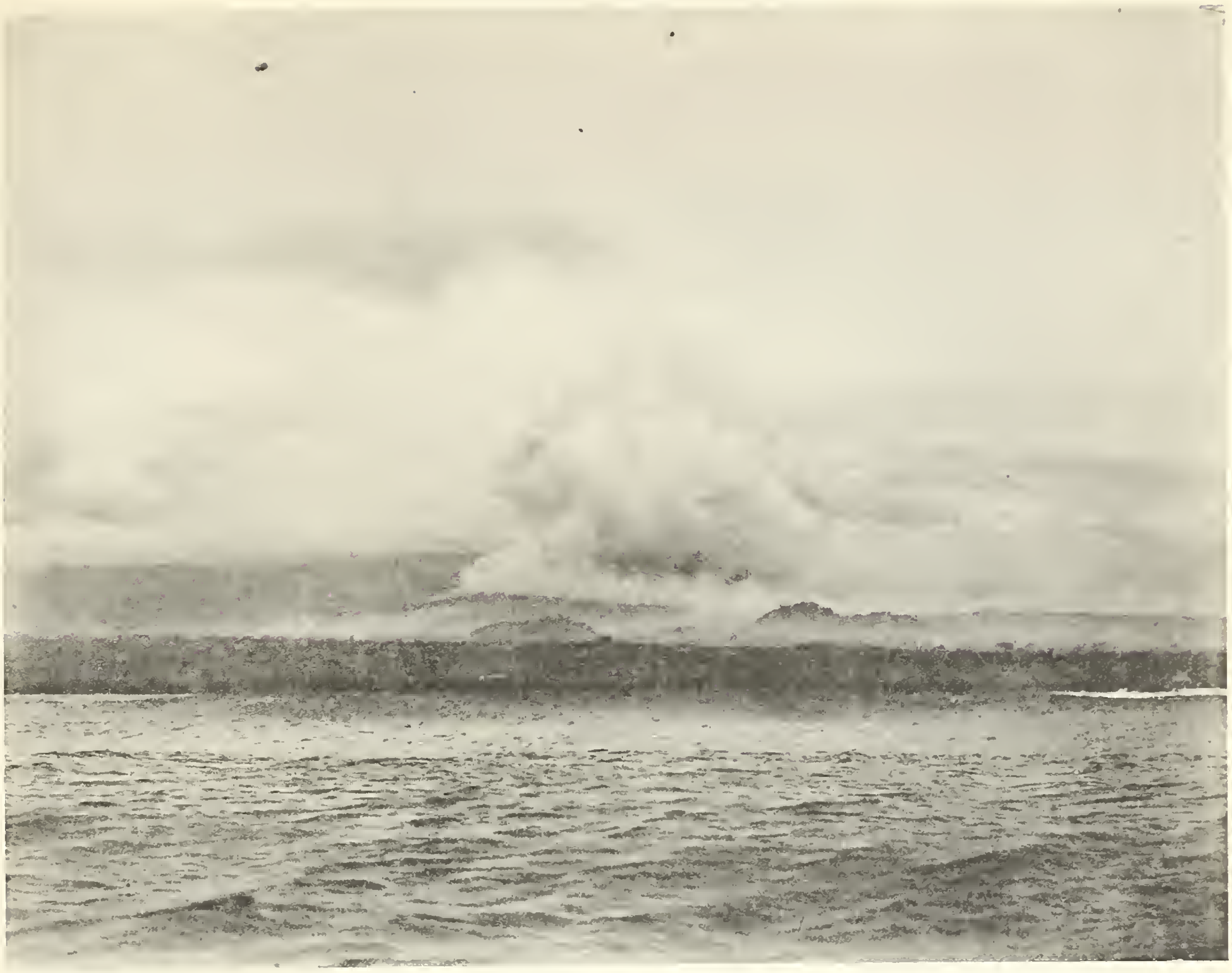
FIG. 1.

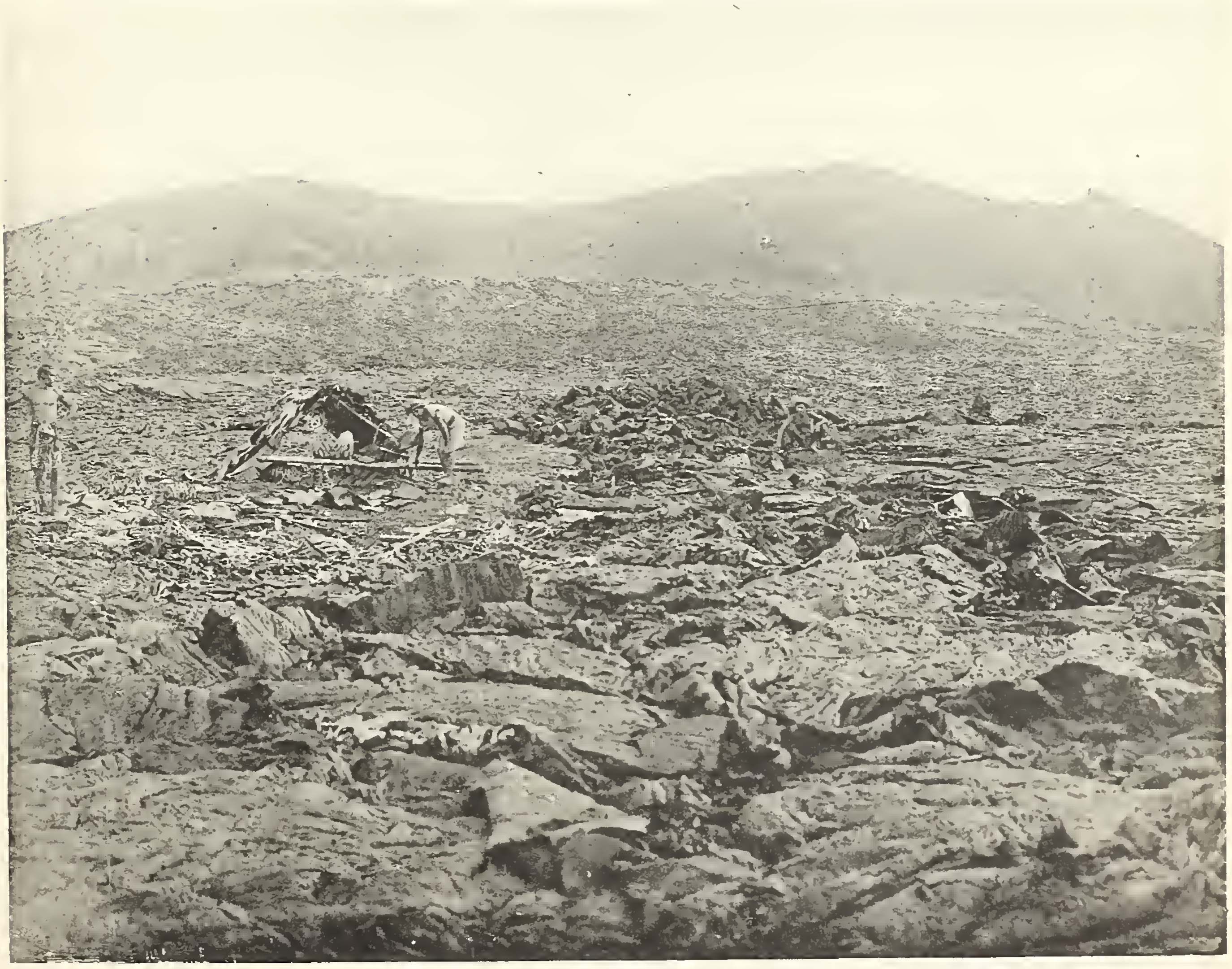
MATAVANU FROM THE SEA.



T. A., Photogr.

FIG. 2.

MATAVANU: THE CONE AND UPPER LAVA-FIELD SEEN FROM THE SOUTH.



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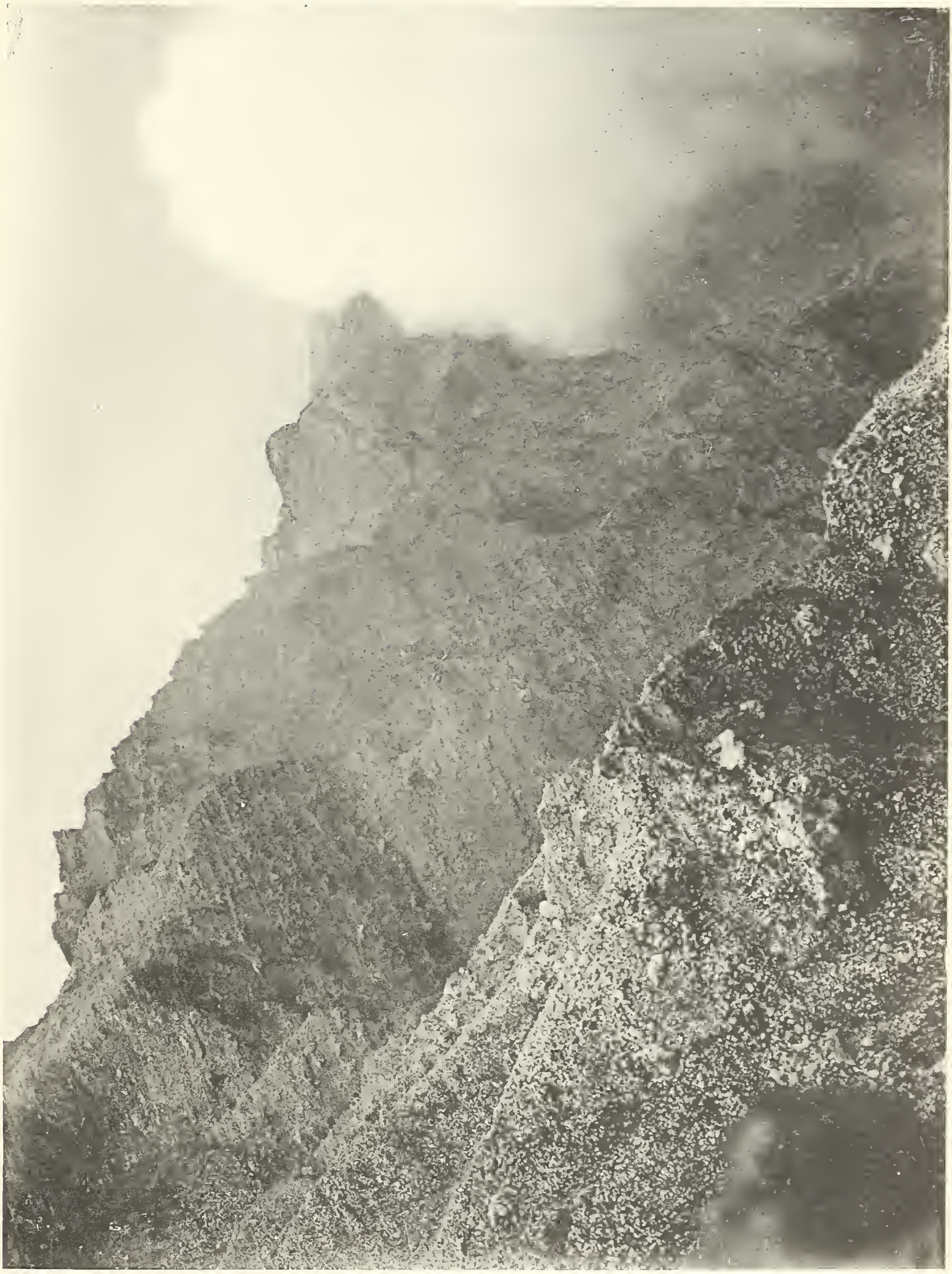

THE SOUTHERN WALL OF THE CRATER.

T. A., Photogr.

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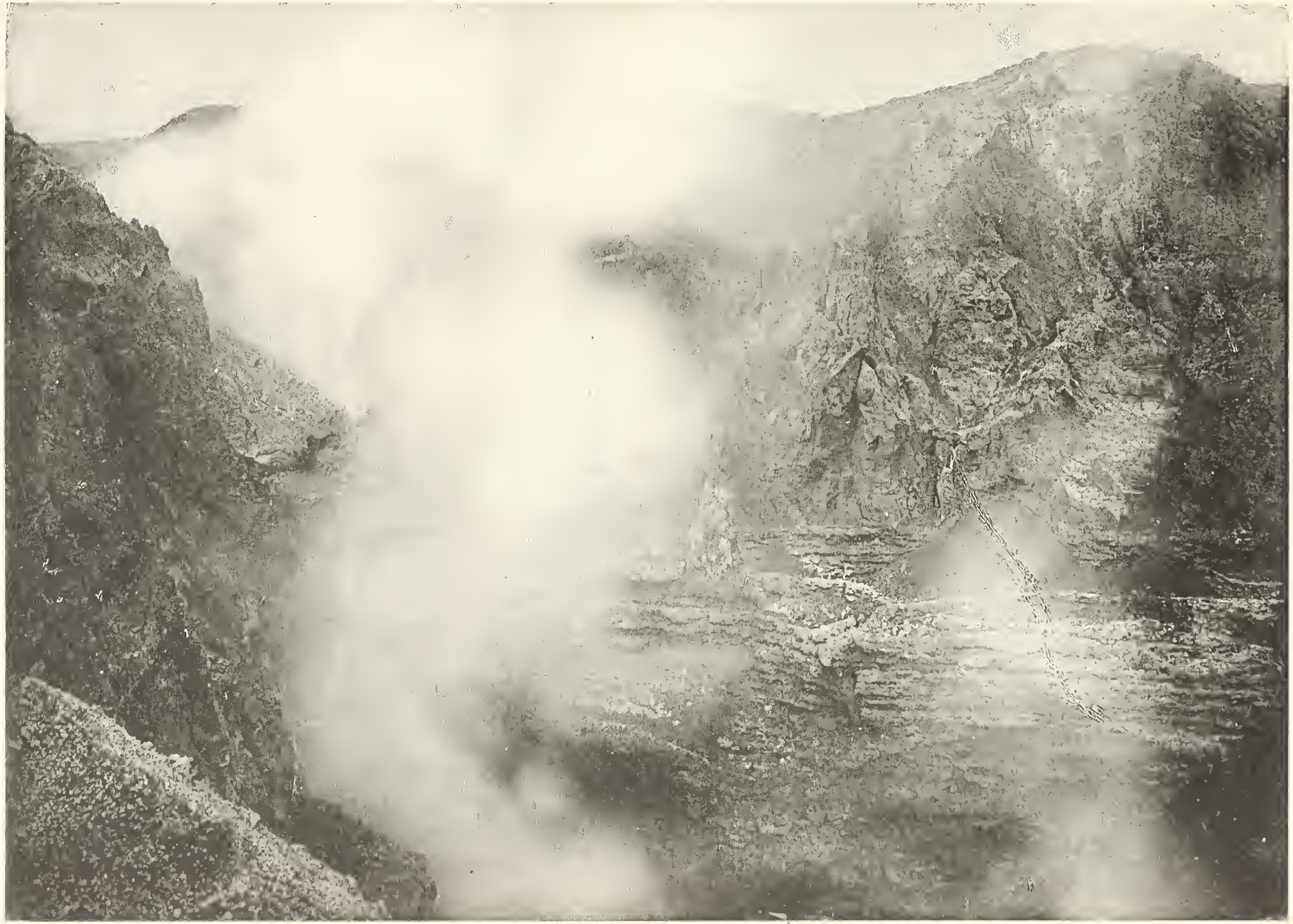
THE WESTERN END OF THE CRATER. TO THE LEFT THE PICTURE SHOULD JOIN THE LAST (PL. XLVI).



T. A., Photogr.

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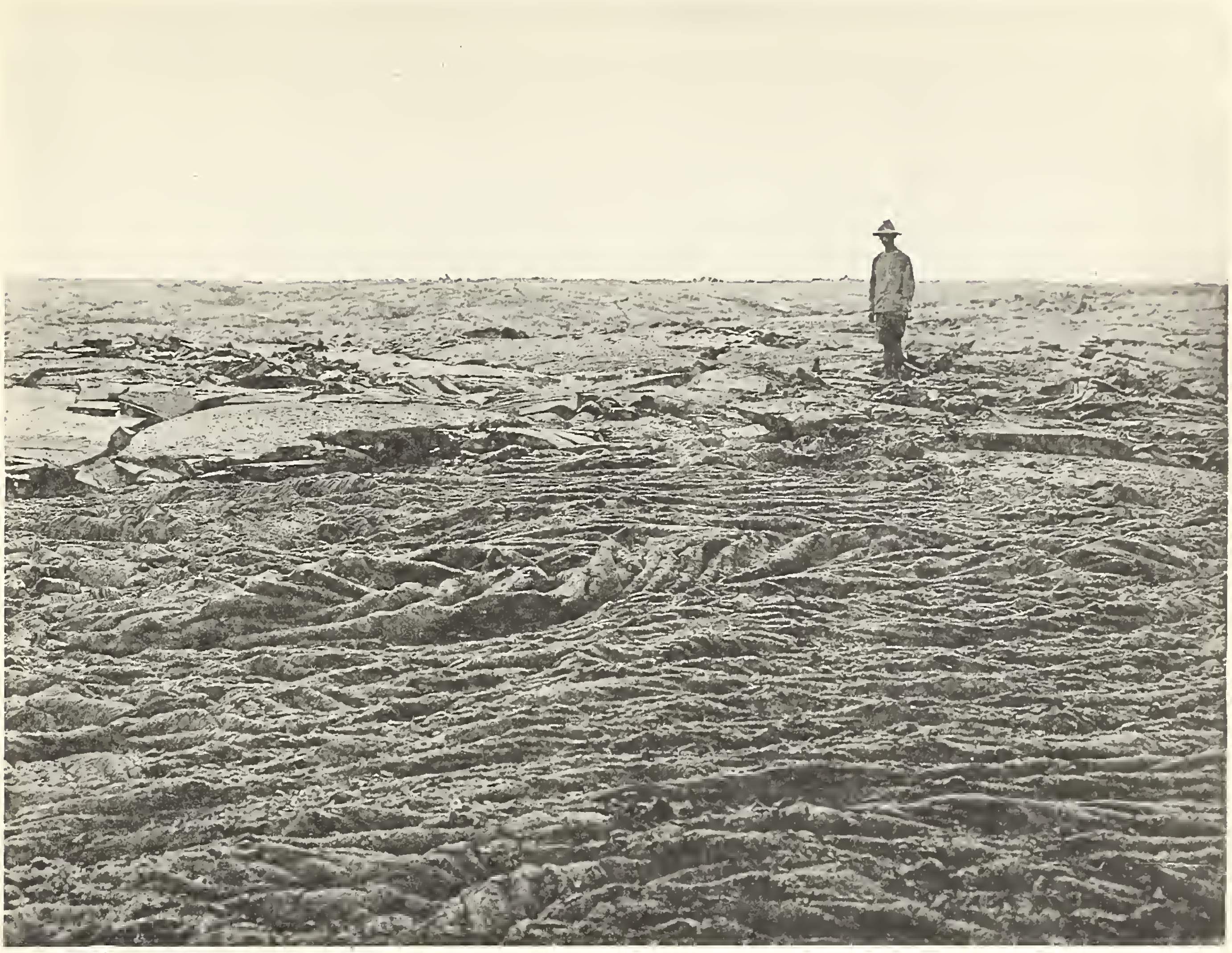
FIG. 1.

SLAGGY LAVA (PAHOEHOE), SHOWING CORDED STRUCTURE.



T. A., Photogr.

FIG. 2.

LAVA-FIELD WITH BLOCKS BROKEN UP BY INTRUSION OF LAVA. FUMAROLES ARE SEEN ON THE LINE OF THE PRESENT UNDERGROUND FLOW.

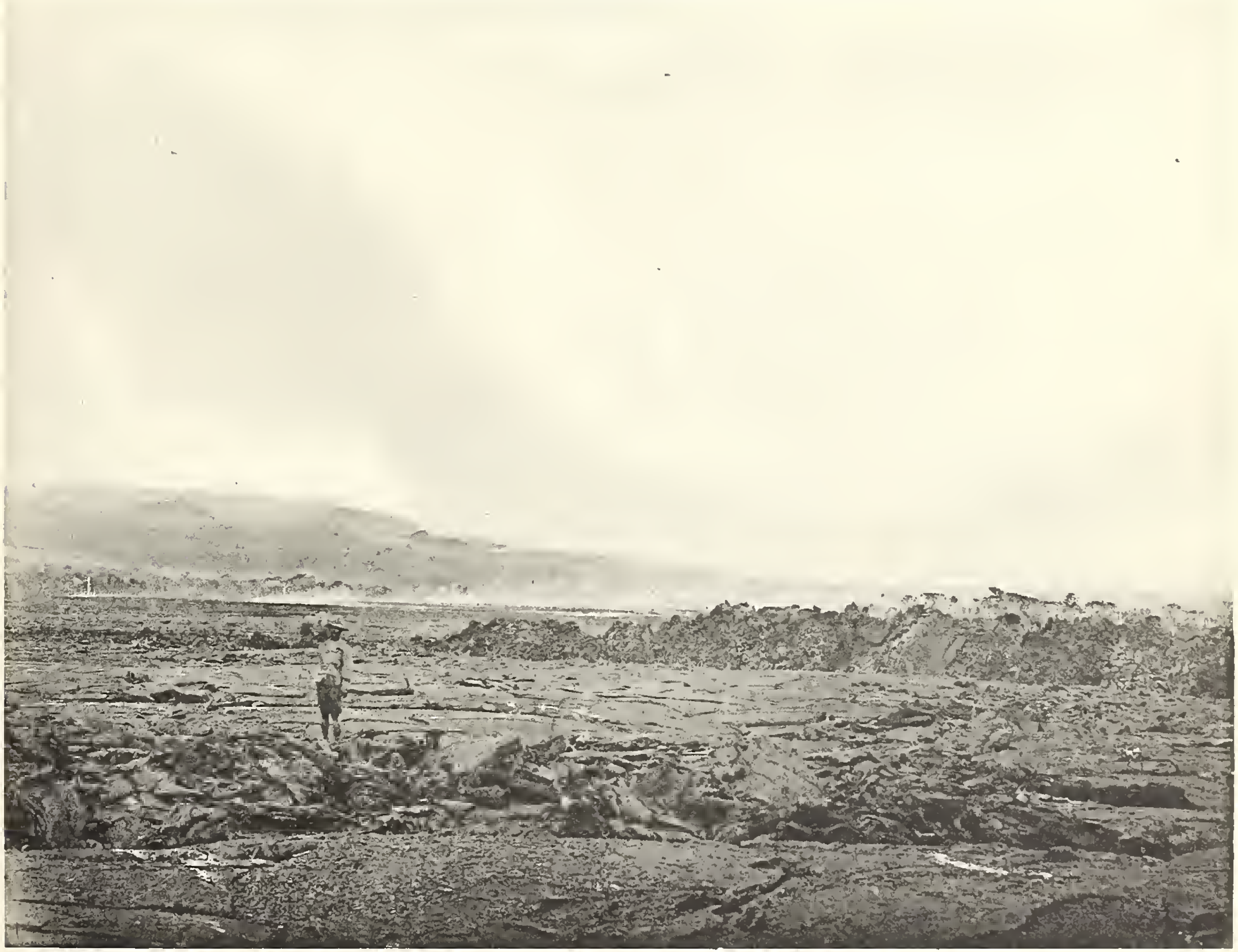


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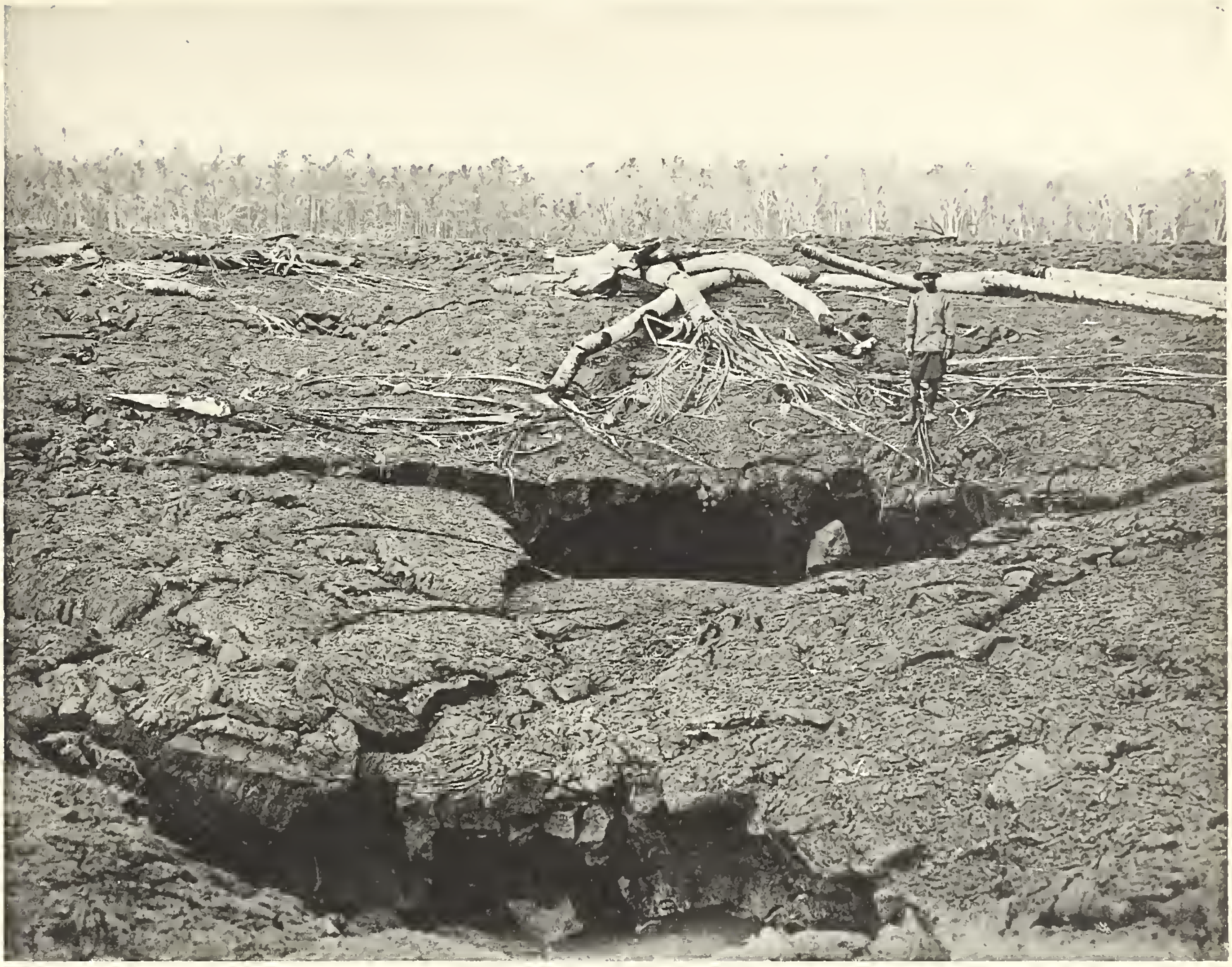
FIG. 1.

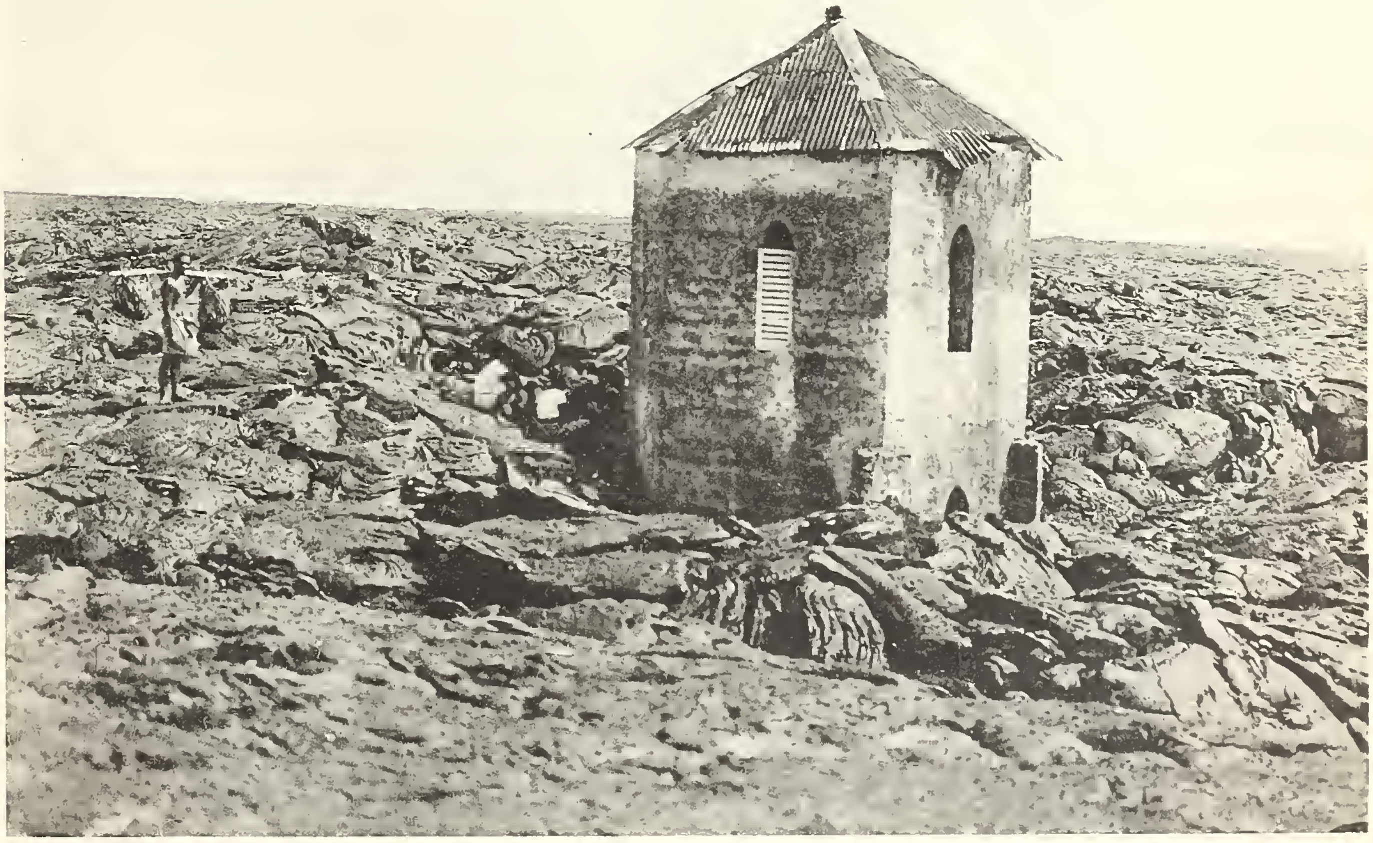
LAVA WITH SUBSIDENCES AND A TUNNEL.



T. A., *Photogr.*

FIG. 2.

THE TOWER OF THE CHURCH OF SATAPUTU IN A DEPRESSION IN THE LAVA-FIELD.



T. A., *Photogr.*

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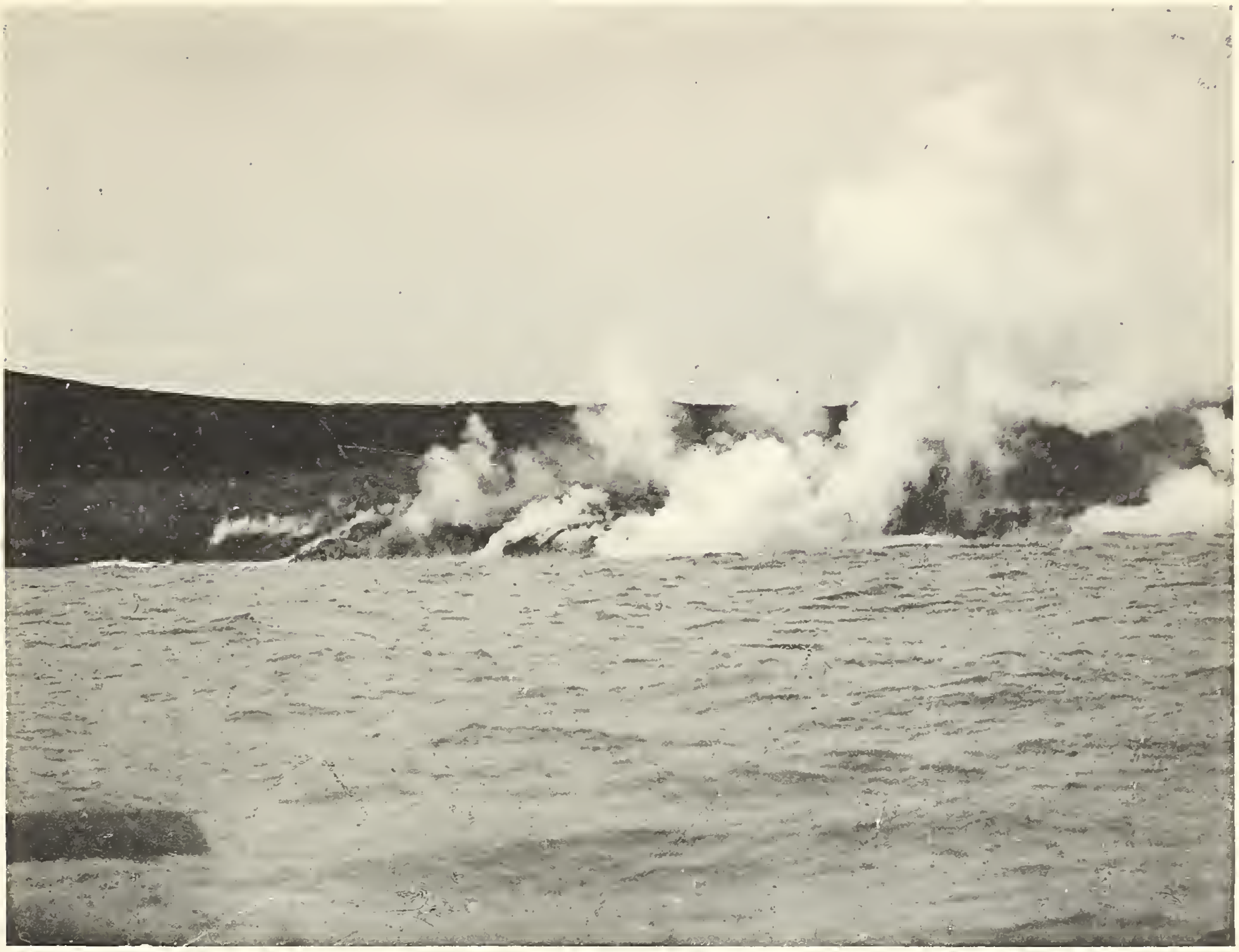
FIG. 1.

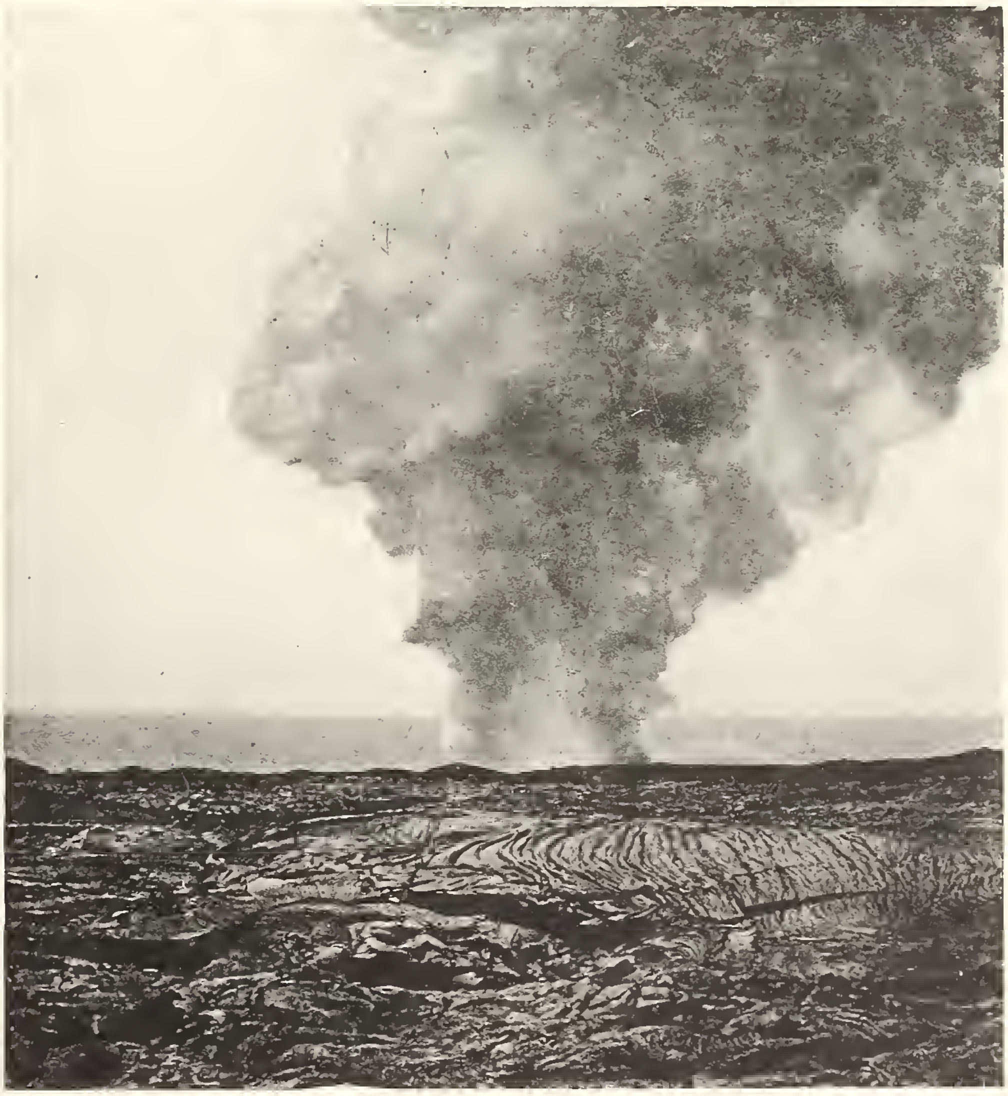
THE LAVA FLOWING INTO THE SEA.



T. A., Photogr.

FIG. 2.

THE STEAM-CLOUD AT ASUISUI: IN THE FOREGROUND IS HOT LAVA.



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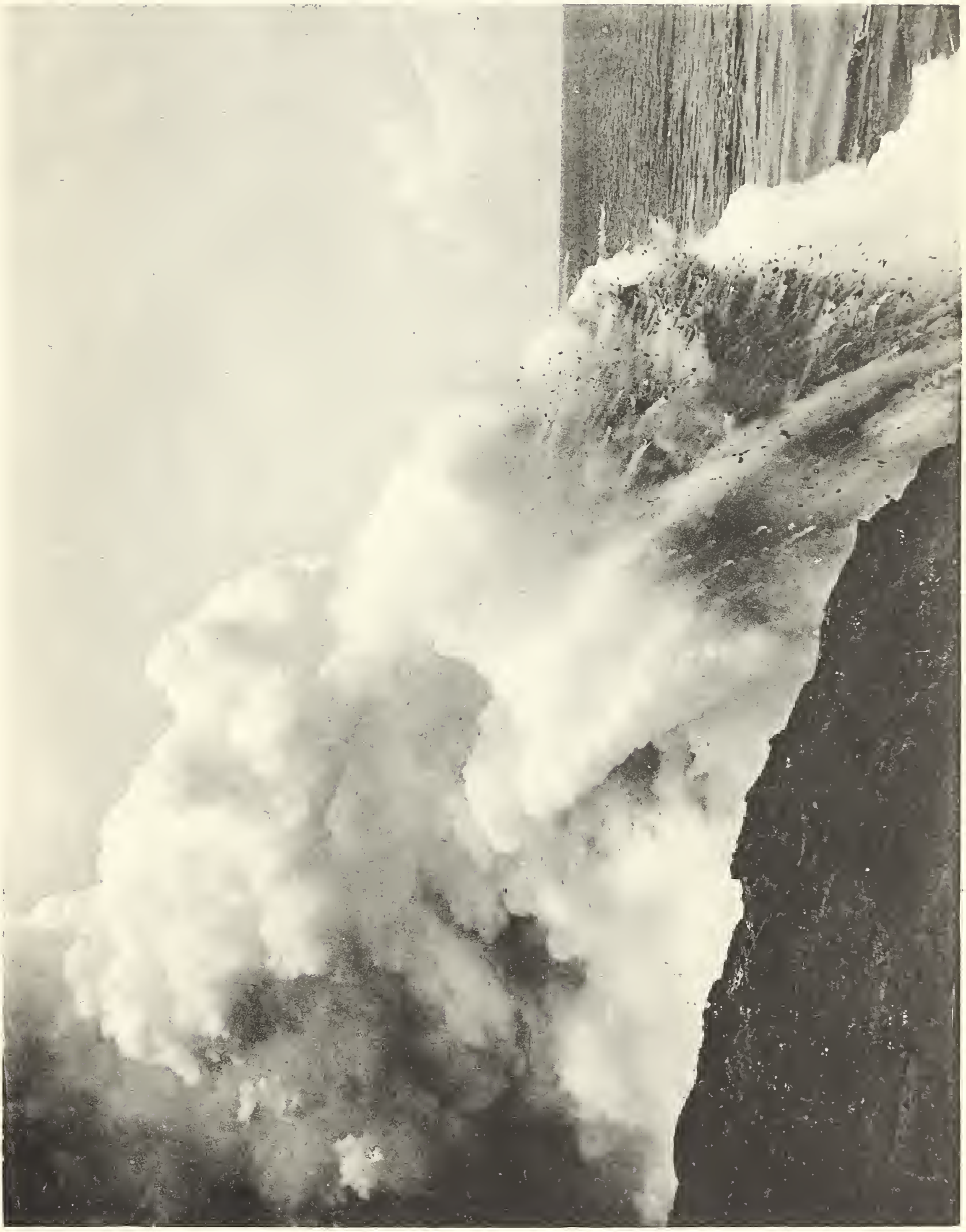


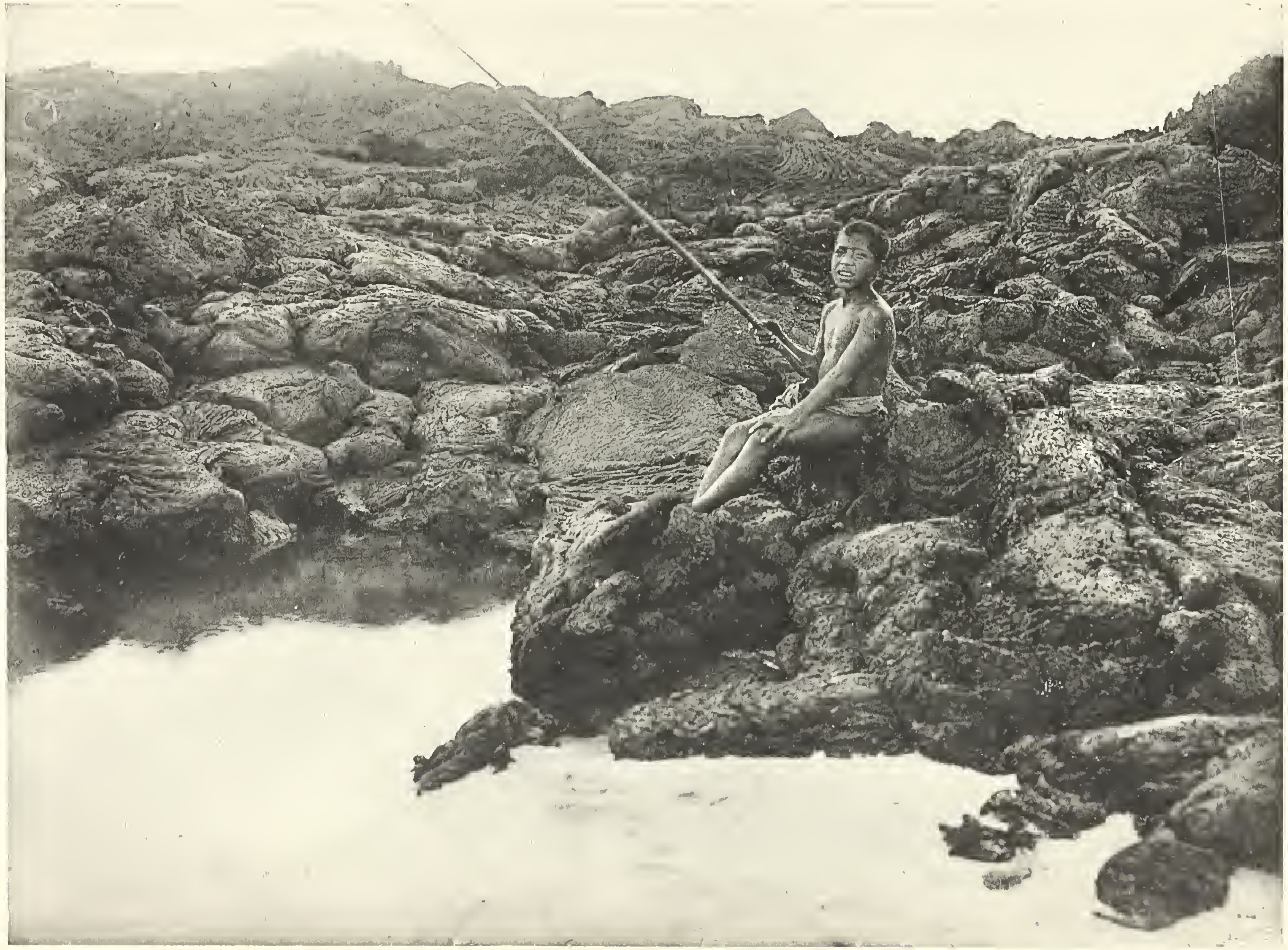
AN EXPLOSION AS THE LAVA FALLS INTO THE SEA.

Capt. Allen, Photogr.

Bemrose Ltd., Collo., Derby.

LAVA IN THE LAGOON:

IN THE DISTANCE, ORDINARY PAHOEHOE; IN THE FOREGROUND, PILLOW-LAVA CHILLED BY SEA-WATER.



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